CANMET

COAL RESEARCH LABORATORIES

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COAL RESEARCH LABORATORIES
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FOREWORD

The Coal Research Laboratories have continued to strengthen their links with the operating arms of the coal and tar sands mining industries of western Canada. Opportunities for joint research and development have added an expanded dimension to the programs in both the laboratory and on-site and have included collaboration with the processing researchers of western Canada's tar sands industries in addition to the well established mining technology links.

Collaboration with the Cape Breton Development Corporation is now directed through a joint steering committee; consultation between researchers and operators continues on a daily basis. The working relationships with the Coal Association of Canada allowed use of CANMET's expertise during formative discussions on mine-site technology which were subsequently incorporated into some elements of the report of the Secretariat to the Premier's Task Force on Western Coal to Ontario. Staff at Devon were also involved in oil emulsion technology reviews and demonstrations. Each of these activities exemplifies a different approach to consolidation of industrial links and to reinforcing the impact of industrial technological needs on the immediate direction of the research efforts within the laboratory. These efforts will be further reinforced, during 1988/89 by a more structured approach to business development.

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AVANT-PROPOS

Les Laboratoires de recherche sur le charbon ont continué à renforcer leurs liens avec les divisions opérationnelles des industries d'exploitation du charbon et de sables pétrolifères de l'Ouest canadien. Au cours de l'année, les occasions de participer à des projets conjoints de R-D ont permis d'ajouter une dimension nouvelle aux programmes de recherche tant au niveau du laboratoire que des travaux sur le terrain. Ces projets ont également permis au LRC de collaborer avec les chercheurs en minéralurgie des industries de traitement des sables pétrolifères et avec les contacts bien établis dans le domaine de la technologie minière.

La participation des Laboratoires avec la Société de développement du Cap-Breton est maintenant dirigée par un Comité directeur conjoint. Cependant, les chercheurs et les exploitants poursuivent leur consultation sur une base journalière. Les relations de travail entre l'Association charbonnière canadienne et CANMET ont permis à l'Association de faire appel à l'expertise de CANMET au cours de discussions formatrices sur la technologie de l'emplacement des mines. Ces discussions ont fait ultérieurement l'objet de certaines parties d'un rapport préparé pour le Premier Ministre de l'Ontario par le Secrétariat du Groupe de travail sur le charbon de l'Ouest canadien. Le personnel du Laboratoire de Devon a participé également à des études et démontrations technologiques sur les émulsions de pétrole. Chacune de ces activités reflète une approche différente à la solidification des liens avec l'industrie et sert à renforcer l'impact des besoins technologiques de l'industrie sur l'orientation immédiate des efforts de recherche au sein du Laboratoire. Au cours de l'année 1988-1989, l'accent sera mis davantage sur ces efforts au moyen d'une approche plus structurée axée sur le développement commercial.

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HIGHLIGHTS

CAPE BRETON COAL RESEARCH LABORATORY

Joint cooperative research between the Cape Breton Development Corporation (CBDC) and Cape Breton Coal Research Laboratory (CBCRL) has become consolidated through the processes of the Joint Steering Committe meetings held at three monthly periods.

The purposes of these meetings is to review ongoing joint cooperative research projects to which both CBDC and CBCRL are committed, discuss new projects and steer them into reality, and to report on the conclusion and findings of completed projects.

The idea to hold such meetings was first suggested by R. Cooper, Vice-President Mining Operations CBDC during mid-1986 and was immediately accepted by CBCRL.

With the experience of six such meetings, four being held during the FY under review, their value is becoming more clearly evident to both parties. The continuation of these meetings is a vital part of the on-going health of joint cooperative research.

In support of some of the agreements at such meetings 672 person days were devoted by CBCRL staff to field studies for trials and the collection of data from within CBDC's three operating mines during the year.

SURFACE MINING LABORATORY

This year has seen the consolidation and continuation of industrial consultation and collaborative research activities. Industry's willingness to participate in cooperative R&D as individual firms or consortiums in spite of the continued downward pressure on product pricing and the resulting difficulties is noteworthy.

Blast casting at Fording, OBDAS at Gregg River, biological control of methane at CBDC, and dynamic stability of waste dumps at Smoky River are all examples of collaborative research projects undertaken at the mine site. When combined with in-house efforts on such projects as the AOSTRA underground test facility, Easi-miner simulation and the rolling resistance

trailer as well as cost recovery spontaneous combustion and methane desorption work it is clear that the laboratory has established itself and is working effectively at its new location in the Devon Coal Research Centre.

Increasingly this year the Surface Mining Laboratory has been asked to participate in large scale mine site demonstrations of new technology. Those projects are large and have resulted in the laboratory looking for sources of funding external to CRL sources of funding. In FY 88-89 we expect to make increasing use of the DSS Unsolicited Proposals Program, DRIE Microelectronics and Systems Development Program, NRC Industrial Research Assistance Program, NSERC and CANMET's Matching Funds Program. In addition, CRL expects to play a technical role in industry-driven projects under the Western Diversification Initiative and Low Sulphur Western Coal to Ontario umbrellas.

In the past two years the Surface Mining Laboratory has made a concerted effort to increase cost recovery, collaborative work and external leverage in contract investigations. Those efforts in combination with attention to business development activities (conference organization, site visits, seminars, public relations and the like) have made our clients much more aware of our capabilities and strengths. That in turn has made our research more reactive and responsive to clients needs.

FUEL PROCESSING LABORATORY

The past year saw a reorganization of research staff within the laboratory, resulting in the formation a section dedicated to the study of heavy oil/bitumen emulsions and a section whose members could be seconded to work on specific collaborative projects with industry.

This review period has been characterized by ongoing efforts to enhance working relationships with industry, to think more in terms of collaborative and cost recovery projects, their impact and transfer of technology to industry and to reduce the level of effort in projects which do not have clearly defined clients.

The CANMET Business Plan (1988-1991) outlined directions and focus in general terms. More specifically, the Minister's National Advisory Council to CANMET (MNACC) made positive recommendations with respect to both coal preparation and oil emulsion activities within FPL, resulting in modified five-year plans. The list of clients of FPL during the past year is

extensive; it includes the major companies involved in oil sands processing and all operating coal companies, equipment and reagent manufacturers, consultants, various industry organizations and outside R&D performers.

Co-operation between resident organizations within the Coal Research Centre Devon also increased; for the first time a joint research proposal from the Centre was submitted to industry in response to a specific request.

Changes inevitably generate some problems; in summary, however, the past year has been one of expanding our client base and being both responsive and efficient within the new guidelines.

CAPE BRETON COAL RESEARCH LABORATORY

RESEARCH AND DEVELOPMENT

TECHNOLOGY DEMONSTRATIONS

Contract review reports have been completed during the year on remote and automatic control systems for longwall mining, on short longwall single-entry retreat systems, and on the development and laboratory validation of a theoretical model of rock/gas outbursts for the Sydney Coalfield.

A research project proposed and supervised by CBCRL was funded by CBDC and was undertaken by the Technical University of Nova Scotia (TUNS). Its purpose was to evaluate grout-filled lightweight tubular section steel arches. The evaluation was completed and a satisfactory report was submitted.

CBCRL staff continued to provide advice and support to CBDC as requested. One example of such support was the monitoring of the advanced heading of 7W Intake gate at Lingan Colliery for support performance and closure.

Information was provided to CBDC on ongoing developments from the United Kingdom, the Federal Republic of Germany and the U.S.A. of water jet assistance and dust suppression modes employed on shearers.

There is a likelihood for the translation of some of these review reports into cooperative demonstrations with CBDC over the next few years.

STRATA MECHANICS

Evaluation of Submarine Subsidence Guidelines

The undersea subsidence guidelines used in the Sydney Coalfield were derived primarily from European land-truthed data extrapolated to undersea conditions rather than derived empirically from seabed-truthed data. Their applicability to a multiseam mining environment with optimal resource recovery is uncertain. Therefore, CBCRL has initiated a long-term program to measure actual seafloor subsidence development, produce effective predictive techniques and establish safe working guidelines consistent with optimal resource recovery for the Sydney Coalfield.

In August 1987, a research contract undertaken by McGregor Geoscience Ltd. (Halifax) completed some 35 km of marine echosounder and seismic survey lines to establish the baseline seafloor topography over the west side of the Phalen resource block, prior to the commencement of mining. The final processing and interpretation of this data as well as its presentation to the mining industry is expected by the spring of 1988. Additional marine surveys are planned once mining of the Phalen 1 and 2 West panels is completed. The object of the future surveys is to rerun exactly the original 1987 survey lines and therefore allow a direct comparison of the two data sets to establish the magnitude of the resulting seafloor subsidence profiles.

In early 1987, CBCRL initiated a joint research program after CBDC expressed concern regarding potential subsidence interaction effects between the Phalen 1 West panel and the Lingan Mine main slopes. An extensive instrumentation scheme, comprising 56 tiltmeters and 15 extensometers, was installed in the Lingan Mine 1, 2, 3 and 4 slopes and monitored regularly between April and December 1987. The instrumentation program was designed to fulfill two main functions: 1) assess the 'angle of draw' between the Phalen and Harbour Seams and estimate the magnitude of the predicted Phalen 1 West panel subsidence profile, and 2) provide an early warning mechanism for the detection and probable magnitude of instability problems which may occur in the Lingan Mine main slopes due to subsidence interaction effects. Little or no movement was recorded on either the tiltmeter or extensometer arrays even when the Phalen 1 West panel exceeded the critical distance required for maximum subsidence development. It is anticipated that further tiltmeter/ extensometer arrays will be installed in the Lingan Mine 1 and 2 main slopes during 1988/89 to monitor potential interaction effects caused by the Phalen 2 West panel.

Roadway Support Systems

CBCRL, in conjunction with CBDC, is examining various alternative methods for the support of major roadway intersections in the main arterial roadways at the Lingan and Phalen mines. At present, the intersections are supported by frameworks of massive steel 'I' beams. To date, work has centered on a research contract being undertaken by Golder Associates (Toronto) to review and evaluate current intersection support systems and

assess their application to the Lingan Mine workings. This contract is expected to be completed by early spring 1988.

During the forthcoming year it is planned that an existing intersection will be instrumented and monitored. This work was originally scheduled for 1987, but was postponed due the lack of a suitable site at the Lingan Mine.

In November 1987, CBCRL was requested by CBDC to initiate a research program to monitor the support system response and geotechnical behaviour of the Lingan Mine 7 West bottom level. The roadway is currently supported using 3.66 m high by 4.87 m wide three-piece yielding arches. A variety of instrument arrays and survey techniques were therefore used to examine the in situ arch yielding characteristics as well as the gateside pack and floor heave behaviour. The results of the ongoing monitoring program were presented on a monthly basis to a working group comprised of both CBDC and CBCRL representatives.

Rock/Gas Outbursts

Since 1977, thirty-seven events identified as outbursts have occurred in the No. 26 Colliery workings below a depth of 700 m. The early events were described as roof falls because of their docile nature and because no methane emission was recorded. However, the two most recent events in November 1983 and January 1984 were particularly violent and resulted in the temporary halt of further 'main deeps' development until a method of control could be implemented. The November 1983 occurrence demolished 18 arches, ejected 300 m^3 of rock and over 750 m^3 of methane. The January 1984 occurrence demolished 16 arches, ejected over 150 m^3 of rock and almost 3,200 m^3 of methane.

The ejected material consisted of pulverized fine/medium grained sandstone. The outbursts only occurred where the overlying sandstone unit came within 2.7 m of the top of the coal, the development roadways were being driven using 'drill and blast' methods and the depth of cover exceeded 700 m. Research to investigate the outbursts phenomena experienced at No. 26 Colliery has continued following closure of that colliery since other CBDC operations are expected to reach similar depths and geological environments within the next five years.

In November 1987, a research contract entitled "Development of an Outburst Model for the Sydney Coalfield, N.S." was completed by Golder Associates of Toronto and the results presented via seminar to the mining industry. In addition to identifying an appropriate outburst model and trying to validate it using the Sydney Coalfield field data, the contract also further examines the role of the rate of stress change on the incidence of bursting.

The University of Alberta (under an EMR-RAP grant) is undertaking a modelling study to analyze the outburst phenomena experienced at the No. 26 Colliery.

Gateside Pack Performance

Monolithic packing systems have been installed by CBDC on the 9E, 10E and 11E panels at Lingan Mine. CBCRL has continued to monitor the performance of these systems, particularly with regard to their effectiveness for reducing gob leakage and providing gateside support.

The 'Astrapack' system currently used is imported from the United Kingdom. Both CBCRL and CBDC have therefore continued to investigate the possibility of using indigenous Nova Scotia materials such as gypsum, anhydrite and fly ash. Work undertaken by L.E. Shaw Ltd. (Halifax), McGill University (EMR-RAP grant) and the Technical University of Nova Scotia (MDA program) is being monitored and assessed with regard to its potential application for use in dual-life retreat roadways at the Lingan and Phalen mines.

Rock/Support Interaction

Between October 1983 and December 1984, and March 1986 and February 1987, a Lovat full face TBM was used to drive the No. 2 (3350 m) and No. 3 (2320 m) tunnels at the Donkin-Morien Mine site. Extensive geotechnical monitoring programs undertaken by CBCRL and Golder Associates (Toronto). - resulted in a total of 20 crown extensometers being installed in the tunnels. During the year CBCRL has undertaken periodic monitoring of the crown extensometers to obtain data on the long-term stability of the two tunnels.

Between February and April 1987 the results of an extensive geotechnical program resulting from the work presented via a joint CRL/OTT/MRL program to the Canadian mining industry by a series of seminars conducted at 17 universities with mining and/or civil engineering (geotechnical) departments.

In November 1987, a 3-year research contract was awarded to McGill University to develop a finite element computer model for the design of steel support systems using the extensive data base collected during the Donkin-Morien Rock/Support Interaction Study for calibration purposes.

Rock Mechanics Laboratory

The rock mechanics laboratory is nearly operational. The MRL Tinius-Olsen test frame was delivered in May 1987. A stiff test frame designed by CBCRL staff and fabricated locally was delivered, but is not yet fully operational. The core drill has continued to malfunction and remedial measures are currently under discussion with CANMET's Technical Services Division.

In early 1987, a joint CBCRL/CBDC research program was established to examine the relationship between rock cuttability and machine performance. In January 1988, CBCRL took delivery of a CERCHAR hardness testing machine and this will be complemented by a CERCHAR abrasivity testing machine which, although purchased by CBDC, will be located in the CBCRL rock mechanics laboratory.

Other Projects

An IBM compatible computer program was developed in August 1987 which undertakes the calculation of roadway closure using the method developed by Dr. A.H. Wilson of British Coal.

The need for a simple yet reliable method for determining the uniaxial compressive and tensile strength of rock, has resulted in further work being undertaken to assess the applicability of the point load testing technique. In December 1987, a research contract was awarded to Maritime Testing (Halifax) to examine the effects of sample shape and point wear on the derived indices of a reference material.

The need for accurate in situ stress data from weak rock and coal has resulted in a research contract being awarded to Strata Engineering Corp. (Toronto) to examine the use of strata reinforcement techniques combined with overcoring methods to determine the in situ stress regime of weak coal measures strata.

COAL MINE ENVIRONMENTS

Methane

The objective of CBCRL's methane research is to improve the management and control of methane emission in underground coal mines, and thereby contribute to the enhancement of health, safety and productivity of the Atlantic Canada's underground coal mining industry.

To contain the methane emission hazard it is necessary to deliver adequate quantities of air to strategic zones in the mine workings and, where necessary, supplement this with effective methane drainage. The ability to predict methane emission volume is a vital element in the ventilation planning process. However, methane emission into mine workings is a complex combination of processes. To study various elements of these processes and to develop a computer-based methane prediction model with real-time inputs, several site specific parameters need to be determined and evaluated. To this end a number of in-house, contract, and joint research projects have been initiated. These are described below.

1. A joint CANMET/USBM investigation of methane liberation patterns in advancing longwall panels in Cape Breton revealed that:
   a) Methane from the seam being mined (intake gate plus wallface) is less than 33 pct of the methane in the panel. However, it is the most troublesome because it can be controlled only by diluting it to safe levels with adequate ventilation. It can be reduced by predrainage but predrainage techniques in less permeable seams, like the Harbour seam in an undisturbed state, are uncertain and tend to be expensive. However, a preliminary study into the feasibility of predrainage in Cape Breton collieries is now under way.

b) Although the methane from the seams above and below (return gate plus methane drainage) constitutes over 67 pct of the total methane in the panel, about 67 pct of this total is currently being captured in the methane drainage system. This capture ratio could further be improved by experimenting with the relevant parameters of the drainage holes and reducing air leakage through the gob.

c) The methane liberated from the coal cut by the shearer does not get diluted as quickly when cutting in the direction of the air current as when it is cutting against the air current.

d) The methane monitor located at the outbye end of the wallface is not always effective in detecting dangerous concentrations of methane at the shearer.

A similar study on a retreating longwall panel in the new Phalen Colliery in Cape Breton is planned for the summer of 1988. The USBM personnel have indicated their interest to participate in the investigation.

2. Using a Conspec processor and direct data link to the Conspec computer at Lingan Colliery, real-time environmental data from several sensors in the mine was collected for over a year. This information is being transferred to VAX computer for analysis. It will be stored on a magnetic tape for future use in methane emission models.

3. An automated state-of-the-art gas desorption apparatus was designed, built and recently delivered to CBCRL. It will be used to:
   - determine methane content of coals,
   - rate of emission characteristics of coals,
   - adsorption/desorption characteristics, and
   - outburst potential of coals.

4. At times of falling barometer, it is well known that the methane from worked out areas pollutes the colliery ventilation system. Unless properly controlled, this could create unsafe conditions in

the mine. At Lingan Colliery of the Cape Breton Development Corporation, the ventilation and methane drainage systems have been adequate to remove any additional methane encountered during periods of falling barometer in the active longwall panels. However, the methane released from the sealed longwall panels during such periods has often raised the methane concentration in the main return airways to unacceptable levels.

A preliminary investigation using the information from the remote environmental monitoring system revealed that the changes in barometric pressure had relatively little impact on the quantity of methane that is contributed from working panels to the mine ventilation system. This could be attributed to the effectiveness of the cross-measure borehole methane drainage practised at Lingan in all active longwall panels. In contrast, the quantity of methane that is contributed from all other areas other than active longwall panels varied substantially and inversely to changes in the barometric pressure.

5. A detailed review of operational experience with the Canadian developed Conspec monitoring system in an operating underground coal mine is completed. Its performance was compared with an alternate system manufactured by Transmitton and installed in another underground colliery. The conclusion is that the Conspec system had relatively more problems, was more labour intensive and encountered poor service from its manufacturer. The Cape Breton Development Corporation recently made the decision to replace the Conspec system with a Transmitton system.

6. Other CBCRL/CBDC joint projects include obtaining drill cores for the determination of in situ methane content of coals and study of migration patterns of methane in coal ahead of the coal face.

Application of Tracer Gas Techniques

Developing tracer gas techniques and applying them to analyze a variety of simple as well as complex ventilation networks continued to be a major research thrust at CBCRL. Sulphur hexafluoride is the widely used and

accepted standard for tracer surveys of mine ventilation. However, there are many ventilation problems that could be better evaluated using two or more tracer gases simultaneously. To this end, two other tracer gases (bromotrifluoromethane and dichlorodifluoromethane) were examined. Their release, sampling and analytical techniques were then developed; and successfully used in underground surveys to analyze ventilation networks. Investigations are under way to evaluate some liquid freons for use in the study of methane migration paths through coal.

The following are some of the examples of the applications of tracer gas techniques during the review period:

1. Survey of auxiliary ventilation systems

   During the year several investigations of ventilation ducts were carried out in CBDC mines. By releasing tracer gas at different points into the ducting, air volume flows at those points were calculated accurately. The static pressures measured at those points were used to calculate pressure drops between the points. This information was then used to calculate resistance factors for the ducting, the magnitude of the leakages and the effectiveness of their installation. This data will further be used in the design and simulations of the future ventilation installations.

2. Air leakage through sealed longwall panels

   Two tracer gases were introduced into the sealed gob areas of two panels through the intake seals. Air samples at selected points in the returns were collected for several days. The time concentration patterns of these tracer gases, defined the effectiveness of seals and suggested possible flow patterns of leaks through the gob areas.

3. Underground fire simulations

   Three possible locations of underground fire were simulated by the simultaneous release of three different tracer gases at strategically chosen points in an intake belt slope. Concentrations of these tracer gases carried with the ventilation

currents were measured in the working districts and in main returns. Concentration time curves prepared for each sampling point were used for the analysis of the airflow distribution in the mine and for the design of the mine evacuation plan.

4. Study of airflow patterns on operating longwall fans

Three different tracer gases were released at three locations (bottom, middle and top) on the wallface. The analysis of air samples collected in the return gate at the outbye end of the wallface allowed the calculation of air volumes passing at each of the release points and hence the leakage through the gob from behind the powered supports.

5. Ventilation surveys in the working panels

Several ventilation surveys using tracer gas were conducted in the working districts at the request of CBDC. These surveys provided the Corporation with accurate information on airflows, gob leakages and ventilation efficiencies.

Airborne Respirable Dust

The objective of CBCRL's respirable dust program is to monitor and develop measures to control airborne respirable dust levels in underground coal mines and thereby reduce the risk of coal workers' pneumoconiosis and pulmonary disorders.

The dust research program in the current review period was adversely affected by the dust scientist's lengthy absence due to illness. In January-February 1987 four dust surveys in two longwall panels were carried out at Lingan Colliery primarily for the purpose of comparison with the respirable dust concentrations measured during the period December 1984 - March 1985. However, this opportunity was used to test a newly purchased real-time dust monitor TM DATA by placing it side by side with SIMSLIN II and Casella 113A gravimetric samplers. The shift-length average concentration determined by the TM DATA was found to be almost identical to that given by the Casella 113A and SIMSLIN II.

During the period July 6, 1987 - July 16, 1987 seven dust surveys were conducted at the Top 7 West Development Heading at Prince Colliery.

Dust sampling for this project was done exclusively by 'area' sampling at six predetermined locations. This was the first part of a joint CBCRL-CBDC project that will examine the effectiveness of dust scrubbers. The second part of this project will be completed as soon as a dust scrubber is installed at another development heading under similar conditions as Top 7 West. Numerous respirable dust sampling systems are commercially available for the determination of dust concentrations in underground coal mines. For the purpose of assessing long-term dust exposure, evaluating the effectiveness of dust control techniques or setting work environment standards, the results obtained by measurements using different samplers must be reproducible and comparable. To this end, various dust sampling systems have been field tested and their precision, reproducibility and relative performance have been studied.

The sampling system presently used by CBDC for their compliance measurements is the Casella Type 113A gravimetric sampler. This sampler has been designed to separate respirable dust from non-respirable dust and conforms to the specifications laid out by the British Medical Research Council (BMRC) and the Johannesburg International Conference on Pneumoconiosis (50% collection of particles with a falling speed equal to that of a 5-micron unit density sphere). This is also the reference sampler used by CBCRL.

Of the various sampling systems studied by CBCRL, the one which has been examined most thoroughly has been the Casella SIMPEDS cyclone fitted with a constant flow pump. This sampling system was designed to the same specifications as the Casella Type 113A, but separates respirable dust from non-respirable dust by means of a centrifugal method rather than elutriation.

A comparison of the Casella SIMPEDS cyclone with the Casella Type 113A was done using measurements obtained from surveys conducted at Lingan Colliery and Prince Colliery. These measurement results were obtained from samplers set up at a common predetermined location (control-point). From these results there should be sufficient evidence to enable CBDC to complement their routine dust monitoring with the Casella SIMPEDS cyclone fitted with a constant flow pump for both their compliance measurements and for their own health and safety requirements. Some immediate benefits would be: 1) ease of calibration, 2) cost, 3) ease of handling and, 4) the

flexibility of being able to do both area (fixed-point) sampling and personal sampling - the Casella Type 113A can be used for area sampling only.

CBDC has expressed interest in collecting as many as 4,500 respirable mine dust samples per year for quartz analysis. This will enable them to compile personal exposure levels as it relates to their own health and safety objectives and also to meet regulatory requirements. Consequently, a proposal was submitted to CBDC by CBCRL to assist CBDC in collecting approximately 500 respirable dust samples from their three operating mines. CBCRL would also assist in having the samples weighed and analyzed for quartz content using XRD analysis procedures. This project will provide CBDC with first-hand experience at collecting a fairly large number of samples and indicate which job types and locations would be most at risk. Sampling would be done almost exclusively by portal-to-portal personal sampling.

COAL TESTING

Laboratory and Field Services

The Coal Testing Facility has analyzed coal samples for the Nova Scotia Department of Mines and Energy as part of the Joint Federal-Provincial Resource Development Agreement and continues to contribute to CANMET's coal reserve assessment sub-sub-activity.

Analysis of Coal Samples

During the year the analysis of 858 Springhill dump samples for the Nova Scotia Department of Mines and Energy were completed. These results along with the results of analysis of an additional 22 coal (channel) samples are reported in the divisional report CRL 87-127(TR), November 1987.

In addition, in-house methane desorption samples, and round robin samples and other miscellaneous samples were analyzed.

Canadian Commercial Coals

Plans are currently under way for a commercial coal sampling program for fiscal year 88-89 with analyses to be included in the CANMET report "Analysis Directory of Canadian Commercial Coals - Supplement No. 7". This program would fall under CANMET's coal reserve assessment sub-sub-activity and had been originally planned for fiscal year 87-88.

Coal Data Bank

During the review period the data bank on eastern coals from Nova Scotia and New Brunswick was installed on CBCRL's Micro-VAX II computer and the contract with the University of New Brunswick for its maintenance was terminated. It is operational and several requests were received for information from the data bank. Appropriate responses were given to all such requests. A copy of the data bank was sent to the Institute of Sedimentary and Petroleum Geology of GSC, Calgary to be incorporated into the 'Canadian' coal data bank. A copy was also given to the Cape Breton Development Corporation.

ASTM Committee D-5 on Coal and Coke

This laboratory is represented on the above Committee; attendance was made at two meetings of this Committee during 1987 at Pittsburgh, Pennsylvania and St. Louis, Missouri. The ASTM Committe D-5 meetings are an opportunity to continuously improve and to formulate new ASTM standard procedures for preparing and analyzing coal samples. During the fiscal year, this laboratory has participated in ASTM round robin analyses.

In addition, this laboratory has promoted a modified procedure for performing % volatile matter tests of sparking coals. This procedure essentially involves pelletizing the one-gram sample prior to running the test. Several round robin samples will be distributed to participating laboratories to evaluate this procedure.

COMPUTER APPLICATIONS AND ELECTRONIC DATA PROCESSING

This section is concerned with the acquisition, installation and maintenance of all computer hardware and software for the laboratory.

Assistance is provided to the staff of this laboratory with special applications for interfacing with instruments used for data collection, and the storage and manipulation of such data.

The activities with which computer services have been concerned during the fiscal year are listed following:

1) Dust survey Data base

The dust survey data base files were transferred from the lab's North Star microcomputers to an IBM PC/AT. This will provide

faster access to the data and will enable a wider variety of software tools to be applied to its analysis.

2) Conspec System 10

Data logged by the lab's Conspec System 10 was transferred to the lab's MicroVAX II. This will enable the data to be more conveniently stored and accessed.

3) Eastern coals data base

The eastern coals data base was installed on CBCRL's MicroVAX II in the early part of fiscal year 87-88. Once the access software was converted and modified to operate on the lab's computer the data base was fully operational. Responses for requests for data were then subsequently completed.

4) Management Information System

A computer link was established between CBCRL and CANMET's Management Information System. This link provides the lab with access to up-to-date information and such services as electronic mail. As well, time sheet information can now be entered directly into the financial network from the lab.

5) Communications

Procedures and software were developed to link the various computing devices within the lab. This enabled greater use to be made of existing hardware and software and provided increased protection for data and a more convenient and efficient upgrading of computer hardware and software. A computer link was also established between CBCRL and CRL Devon.

6) Software

Software was developed in-house as required to meet the specific needs of scientists. Such software created, maintained and modified data base files, interfaced microcomputers and data loggers, and performed a wide variety of data manipulations, calculations and formatting. Some existing software was provided to CBDC after modifications were made to enable it to operate on their equipment.

SURFACE MINING LABORATORY

RESEARCH AND DEVELOPMENT

ADVANCED TECHNOLOGY

The objective of the Advanced Technology group is to conduct industry oriented applied research addressing surface mining methods and systems aspects which offer potential economic benefits to Canadian surface coal and oil sands mines.

The major demonstration project during the year was the application of blast casting techniques at the Fording Coal Mine in Elkford, B.C.. Mountain top removal of overburden by blast casting has been demonstrated to be an economically feasible technique.

Industry consultation has lead to the introduction of a project on Mine Equipment Maintenance. The purpose of the investigation is to study the practices at participating operating mines and to identify areas of maintenanace practices where changes could lead to improved economics. The change may be either by modifying existing operational practices or by incorporating entirely new ones. Information gathered to date suggests that site-specific parameters overweigh the general observation. The maintenance costs at a mining operation constitute a significant portion of total mine operating cost. The project underway includes 5 mines. The success of the project depends on how much information is received for the mining companies.

An overview of microprocessor based devices for equipment performance monitoring was completed and the report circulated. This was followed by visits to mining companies to solicit the comments in face-to-face discussions.

During the year numerous enquiries were received from mine operators seeking advice on individual mining schemes. Nearly two months of time was spent in assisting Syncrude and Suncor oil sands mines in developing a strategy for using hydraulic excavators and mobile crushing units. A cooperative project with Syncrude mine to test a large capacity feeder breaker in their pit is one element of the proposed CANMET matching funds program and consultation with the mine engineering staff continue.

A seminar on footwall slope stability was held in Calgary where information from a previous contract on footwall stability was reviewed together with other geotechnical issues influencing mine planning and equipment selection. Considerable effort was devoted to organize the First

Canadian Conference on Computer Applications in the Mineral Industry held at Laval University in March 1988. Another presentation at the September 1987 District 5 CIM meeting covered the advances in high capacity surface mining equipment using compact bucket wheel excavators.

Work, with the cooperation of the Operations Research group, was initiated to develop a reliability model for off-highway trucks. Regular contact was maintained with industry, Coal Association and Provincial Government agencies to exchange information on matters related to coal and oil sands technology in Canada.

COAL RESERVES ASSESSMENT

A contract report to assess field techniques used to determine in situ bulk density of coal was completed in May, 1987 and distributed to 18 coal companies, utilities and provincial coal officials. A program of field work in western Canada following up on the report's findings may be implemented when more interest is demonstrated and funding becomes available.

During the year, the coal analysis service provided since February, 1975 to the Nova Scotia Department of Mines and Energy, under the terms of a federal-provincial agreement, was terminated by mutual agreement primarily because of the low level of coal exploration in Nova Scotia. The publication of Divisional Report CRL 87-127(TR) in November, 1987 completed the record of analyses of coal, oil shales and peat performed by CANMET for Nova Scotia. Work on the CANMET Report series "Analysis Directory of Canadian Commercial Coals" was postponed. Supplements No. 7 and No. 8 which were planned for 1988 and 1992 will not be produced unless incremental funding is made available to conduct the necessary sample collection and analysis by contract.

CANMET Report 87-3E "Coal Mining in Canada: 1986", published in September, 1987 officially updated Canada's coal reserves to December, 1985 and listed significant operational and technical information about the Canadian coal mining industry up to 1986. It was decided that the next official update of Canada's coal resources and reserves would be published in 1990, jointly with the Geological Survey of Canada. During the year direct contacts were maintained with coal officials in all coal-producing provinces, all coal operators in Alberta, and all major coal operators in Nova Scotia

and New Brunswick. Provincial authorities and coal companies are the major sources of current data on the quality and quantity of Canada's coal reserves.

During the year 2.5 person years were re-assigned from Coal Reserve Assessment to other projects in the Cape Breton Coal Research Laboratory, in line with recommendations of the Coal Technology Sub-committee of the Minister's National Advisory Council on CANMET (MNACC). The majority view of this important committee is that coal supply in Canada is reasonably well-assured for the foreseeable future and some resources could be re-assigned to other research. There was a steady demand from federal, international, provincial and corporate organizations for data and reports generated by Coal Reserve Assessmednt.

ENVIRONMENTAL CONTROL

The objective of the environmental control group is to conduct an industry oriented applied research program addressing spontaneous combustion and related aspects of coal handleability.

Laboratory work on the characterization of western Canadian coals with respect to their susceptibility to spontaneous combustion is being continued. A number of fresh samples were collected, prepared and tested for spontaneous combustion liability and the results analyzed. Tests with additional samples will be continued in 1988-89.

The effect of carbon dioxide saturation for reducing spontaneous combustion liability was studied. It was observed that at ambient temperature treatments with carbon dioxide up to a period of 2 weeks does not reduce the liability to any significant extent. However, carbon dioxide treatment for a period of over 4 weeks reduces potential to auto-oxidation. Commercial application of this technique would require more detailed study.

Work has been initiated to interpret results obtained from crossing point temperatures more effectively using a mathematical formulation based on the cubic spline curve fitting technique. Preliminary results obtained using the new development showed that it is possible to differentiate between various coals with respect to their susceptibility to spontaneous combustion. Work is also in progress to identify the minimum temperature at which accelerated oxidation is established.

A proposal was prepared to study in detail the effect of drying on the spontaneous combustion characteristics of western Canadian coals. The contract was awarded to the University of Calgary and is being monitored.

The work on the contract R&D entitled "Design and Construction of a Test Apparatus for Evaluating Spontaneous Combustion Susceptibility of Canadian Coals" was completed and the final report was reviewed. Based on this report it was decided that construction of a multi-sample test apparatus is not appropriate at this stage.

Contract R&D work on "Biological Control of Methane in Coal Mines, Coal Storage Silos and Shipholds, - Phase IV" was monitored and the report prepared by the contractor was reviewed. A debriefing seminar was held in Sydney, N.S. About 20 Cape Breton Development Corporation (CBDC) management and staff members attended the seminar in addition to personnel from CANMET, Ship Safety (Transport Canada) and Office of Technology Transfer. CBDC agreed to provide all facilities to carry out large scale tests at their property.

The work statement for Phase V was completed and the contract was awarded to Gemini Biochemical Research Ltd. An 1800 litre bioreactor was installed for producing methane oxidizing microorganisms on a large scale and stability and activity was established. The bacteria was concentrated and later shipped to CBDC and field tested in a 80 ton rail car. Tests were partially successful. More R&D work and further tests are needed before this technique can be considered satisfactory on a larger scale.

Methane desorption and spontaneous combustion characteristics for eight boreholes samples were completed and test results interpreted in terms of spontaneous combustion liability and gassiness of this seam. This subbituminous coal is intended for use in power generation. This was 100% cost recovery work.

At the invitation of The International Maritimes Organization a paper discussing methane control during coal shipment was presented at the Ninth International Symposium on Transportatioan of Dangerous Goods by Sea and Inland Waterways held in Rotterdam in April 1987.

GEOTECHNICAL ENGINEERING

Discussion with the Industry

Industry oriented applied research being CANMET's principal objective, discussions have been continued with the coal operators, consultants, universities, regulatory bodies and other organizations with a view to identifying research requirements, setting research priorities, developing collaborative research projects, harnessing the research expertise and last but not least maintaining an effective level of technology transfer. About a dozen site visits were made to make presentations of CANMET's structure and objectives as well as the mechanisms of developing cooperative research projects and other aspects. Discussions have also been held with different organizations and research projects have or are being developed in keeping with industry's interest.

Slope Stability

The work on slope stability has been principally on slope design, evaluation and monitoring.

Through a jointly funded cooperative research project with Transalta Utilities Ltd., a finite element model - Rheological Element Model (REM) - has been developed. The result was presented to the industry in a seminar. Verification and calibration of the model has been in progress as a jointly funded cooperative extension of this work. This will verify and calibrate the model by comparing the data predicted from the model with those from actual field measurements.

A jointly funded cooperative project has been developed with the University of Calgary to evaluate a slope stability model on a supercomputer. Industry will provide some data for this purpose. The main objective is to evaluate the suitability of supercomputing technology for applications in mining in general and in slope stability in particular.

Waste Dump Stability

The stability of coal mines waste dumps has been identified as a serious generic problem. CANMET has been involved in two projects intended to help solve the overall problem of waste dump stability. One of these projects is a regional study of the stability of live waste dumps. This has

been a cooperative project with the following participants:
CANMET, B.C. Government through B.C.-Canada Mineral Development Agreement (MDA), The Mining Association of B.C. and the six major coal mine operators in B.C. The study has identified the different aspects of dump stability problems, and has made suggestions for further work.

CANMET has also developed another jointly funded cooperative research project with Smoky River Coal Ltd. to study the dynamic stability of waste dumps. The purpose is to study the effects of blasting vibrations and other dynamic stresses on the stability of a dump which has been otherwise statically stable.

Downhole Geophysics

This has been the second year of the jointly funded cooperative work between CANMET and an industry consortium. The object of this study is to evaluate the potential of borehole geophysics for applications in geotechnical and hydrogeological problems. The work on this project is expected to continue into next year. A parallel companion study is funded by AOCRT and the same industry consortium.

Technology Transfer

Technology transfer - the ultimate goal of any industry oriented applied research - demands special emphasis through different means. Several presentations were made to the industry on CANMET's structure, activities and achievements. Research results were presented in local, national and international seminars/conferences. Seminars were organized to advise the industry and others on the success of the work on the REM slope stability model and on steeply dipping footwalls. The results of the work on regional stability of coal mines waste dumps were also presented to the industry, although as direct participants they are very aware of that work.

AOSTRA Underground Test Facility

A major activity during the past year has been the start of the geotechnical investigations at AOSTRA's underground test facility (UTF). This is a joint project with AOSTRA to measure geotechnical movements at the underground test facility during the in-situ steaming of the oil sands.

Nineteen measuring stations have been created in the underground tunnels and well chambers of the UTF. These have been equipped with extensometers, temperature strings and convergence arrays and will be monitored closely to insure continuing stability of the facility during the steaming process. The data collected from these underground installed instruments will be used to determine the likelihood of causing instability in other locations where similar high temperature/pressure wellbores might be installed (ie. future processes at the UTF).

Movements and changes in the pore pressure and temperatures in and around the steamed oil sands are being monitored by instruments which have been installed from surface in deep boreholes. These include multipoint extensometers, temperature sensors and piezometers. Horizontal movements are being monitored using a gyroscopic borehole deviation tool in several vertical boreholes. All of the above instruments will be operating at depths greater than 150 m and at temperatures and pressures in excess of 200°C and 2000 KPa. This part of the program represents a significant advance in installing geotechnical instruments at depth to survive in what will become an arduous environment.

Data collected from the surface installed instruments will be used in numerical simulators, both reservoir and geotechnical. Analyses using these models together with the results of an extensive laboratory testing program will allow an improved determination of the in-situ mechanical properties of oil sands. Observations and analysis should also allow a better determination of the affect that the thermal/pressure induced mechanical response of the oil sands has on these types of in-situ processes. An improved understanding would then allow these affects to be optimized in future projects.

OPERATIONS RESEARCH

The objective of the Operations Research Group is to apply scientific methods of analysis to the management and deployment of surface mining equipment. Examples of the type of activities related to this research include system analysis, data gathering, time studies, and computer simulation of mining equipment.

The benefits of operations research activity include:

- from systems analysis, one may obtain a keener sense of the critical aspects of unit operations,
- from the data acquisition process participating mines obtain a very accurate picture of their operations that may highlight areas of potential improvement, and
- from modelling and validation processes industry obtains a tool that is proven for Canadian conditions and that can be used for planning and scheduling purposes.

Additionally monitoring technology is obtained or developed for the data acquisition activity that can be used in the equipment management process.

The objectives of operations research are straight forward: to provide the knowledge to make informed decisions in the medium and long term, and to provide mechanisms where the operations are controlled and optimized in the short term. In practical terms this involves data acquisition and monitoring, system analysis, modelling and finally the return of this information into the managerial process.

Truck/Shovel Modelling

A steady-state model of truck/shovel operation has been completed and validated. This model was jointly developed with the National Research Council (NRC) in Ottawa. The model include data files from eight western Canadian coal mines, nine loader/shovel manufacturers, and eight off-highway truck manufacturers. A user friendly data entry package matches mine conditions with selected loading and hauling equipment to provide best route selection or best equipment match for particular scenarios.

The dynamic event-based model uses data provided by the deterministic model and may be used for short or long term mine planning, to investigate problems and practices which affect equipment operating cycles and dynamic equipment interaction.

A module, containing various knowledge-based sub-modules and expert guidance systems, is under development. The system will assist users in proper and efficient use of other modules and will utilize menues and prompts designed to carry out the particular tasks.

Continuous Mining Modelling

An event-based model of BWE/conveyor/bin operation, developed by NRC was validated. The model operates on an event-by-event basis, various types of excavator cuts are analyzed separately. The model is dependent upon bucket wheel excavator parameters, stochastic time variables, and geological data. Output reports such as initial condition reports, production summaries, performance indicators, time statistics, histograms, time histories and graphical displays are included as part of the simulation. During validation of the model the documentation and general adequacy of the software was examined and tested using data supplied by mining companies to compare calculated values with actual data.

Another continuous mining system module, to simulate activity of the Easi-Miner machine, was developed to allow insertion as the loading module of the truck/shovel model. The user has the ability to choose the continuous mining system module as an optional loading system. The measure of operation performance is the production rate. A stochastic simulation is used to reflect the random variation in duration of continuous miner and trucks activities. Data was collected from an operating mine by time studies and analysis of production records.

Software for the numerical evaluation of conveyor belt lengths as a function of the installed power was developed to calculate the maximum permissible length of a single flight conveyor. A set of tables and plots are produced to give the user an opportunity to do estimation and quick calculation.

Dragline Modelling

A computer program, developed at Queen's University, to analyse different dragline mining methods, was used to examine problems in dragline selection for one mining company. The program was validated with actual field data and used to analyze several alternatives of pit configuration and equipment requirements.

A study was completed to examine two approaches to the development of computer programs of dragline operations - the use of interactive graphics and expert systems - by reference to a common surface mining problem,

planning of dragline operations. An interactive, graphical program was used to produce an animated dragline which is manipulated on the screen until the operator has produced a satisfactory solution. The second program uses the features of the Prolog programming language to select sets of input values and criteria for eliminating unacceptable solutions. The program then lists all possible mine designs that meet the criteria.

Equipment Monitoring

The ability to predict equipment performance from a model is dependant upon the ability to monitor accurately the actual performance of equipment in the field. Field monitoring results serve as input data for predictive models and as review information for equipment management. In practice the data collection procedure is the same for both.

The collection of mine site specific equipment performance data for the variety of conditions encountered in Canadian surface mines is a complex and expensive process. While the Operations Research group is committed to the collection of such data the support of industry is essential.

A total of eight surface coal mining companies in Canada cooperated in data collection for validation of the truck/shovel computer model. Dragline performance data were collected at two mining properties and used for equipment analysis. A review of existing data collection and truck management systems was completed and led to a joint demonstration and evaluation of an integrated truck management system with Gregg River Resources near in Hinton, Alberta.

A study of truck performance and the sensitivity of mine profitability to the condition of haulage roads, resulted in development of a simple standard device for measuring rolling resistance. The rolling resistance measurement device is a single axle trailer with a compartmented water tank (to vary axle weight), a towing bar/force transducer, and a data acquisition system. Realistic rolling resistance values can be used to more accurately predict cycle times and thus haulage requirements. Also the additional data will allow an economic model to be built on the effect of roadway construction and maintenance practices on overall haulage economics, allowing optimization.

Data acquisition initially constituted time studies using a stopwatch. Later, new microprocessor based data loggers were customized to record events and other data. At the end of the shift the data is downloaded, either directly onto a personal computer or by modem to the Laboratory's mini computer which is used for data analysis. The Laboratory is currently working on an updated general purpose telemetry system to be used for a wide variety of mining tasks: data acqusition, monitoring and more complex communications such as those associated with truck dispatching.

Cooperative Research

Individual projects are undertaken on a variety of scales. Smaller projects, such as the dragline modelling project currently underway, are relatively straightforward and are performed in-house. In other cases the analysis, the definition of model requirements, model building and its validation has been overseen by other organizations working under contract or in cooperative ventures.

The Surface Mining Laboratory research program in Operations Research was initiated as a result of strong indications of industry support. To date industry has provided assistance in model development, has supplied and assisted in the collection of field data and has in some cases provided direct financial support to particular projects. Successful continuation of the work is dependent upon continued industry support and active cooperation. The intent of the work done by the Operations Research group is to produce outputs that are relevant to the needs of industry. Such relevance is best ensured by continuing close working relationships.

Two major cooperative projects are presently underway:

- demonstration and evaluation of on-board data acquisition system, joint project with Gregg River Resources in Hinton, Alberta, and
- development, demonstration and evaluation of an Integrated Truck/Shovel Operating and Management System.

The On-board Data Acquisition System (OBDAS) was installed on two Euclid R-170's off-highway trucks operating at the Gregg River mine and tested for the period of six months, starting in January, 1987. During this time a series of studies were carried out to test the reliability, accuracy, and repeatibility of the system. It was concluded at the completion of the

project, that the system proved to be dependable, accurate and can provide productivity and cost improvements to the mine haulage function. The system also demonstrated the ability to develop the information base and real time monitoring needed to develop a dispatching system. The microprocessor used is also able to accept additional input that could increase its use as a maintenance monitoring and planning tool. Gregg River Resources has estimated that the investment of less than $100K in hardware has produced overburden operating cost savings of $250K pa.

The Integrated Truck/Shovel Operating and Management System is in the initial stage of development. The project is intended to start in April 1988 and is proposed to be complete in three years. The system consists of five different components:

1. Computer Simulation Program

This program is intended for short to medium term production scheduling and should continually accept and process on-site generated data. The program is expected to be developed in several modules that may be used independently. It will accept real time data generated and collected by the mine site equipment information system and drive the dispatching system.

2. Dispatching Program

This program should dispatch trucks in real time in accordance with mine site policies. It is proposed that the dispatching system be set up at the beginning of each shift, monitor truck/shovel performance in relation to this basic set-up, and reassign in keeping with specified mine site requirements. This system must allow for user interaction at anytime, and provide trend information as specified by the user.

3. Equipment Information System

This system is expected to monitor relevant operating, maintenance and equipment performance data and feed this data for further processing in simulation and dispatching programs. Types of data covered by this information system are expected to be defined by the users and may include operating and maintenance data.

4. Data Transfer System

A radio based two way communication system that can send monitored information to a central computer for processing, and relay dispatch decisions as well as provide voice communication is proposed. This system must also provide temporary on-line storage of data for "on demand" transmission and further processing.

5. Mobile Equipment Location Devices

This hardware and program software will locate and continuously update equipment location using satellite or terrestrial based facilities. This system is defined as an assembly of technologies and ment that permits centralized and automatic detection and display of the position and movement of vehicles through an area. The results of this system component will be integrated into the simulation program that drives the dispatching module.

In essence the computer simulation program will take equipment information and location system outputs relayed by the data transmission system, conduct simulations, apply the logic of the dispatch program and inform equipment operators of dispatch decisions.

The central computing facility may also subject the collected data to other analyses to provide operating, management and maintenance information. Data base design is fundamental to this program. The data base design must not only provide data access for all modules but must also recognize future advances and extensions to the system.

FUEL PROCESSING LABORATORY

RESEARCH AND DEVELOPMENT

CARBONIZATION SECTION

The main function of the section is to carry out pilot scale and lab scale carbonization tests on metallurgical coals, their blends and pretreated coals, in order to provide information for Canadian coal producers and improve the marketability of Canadian coals.

The CRL Carbolite pilot scale moveable-wall coke oven together with its auxiliary facilities is one of only three existing in Canada. It is internationally recognized; tests and analyses of resultant cokes have been performed in co-operation with steel companies and coal companies through the Canadian Carbonization Research Association.

Coal/Coke Evaluation

Since 1973, the carbonization unit has evaluated metallurgical coals in terms of their physical properties only. However, a full knowledge of coal/coke analyses and characteristics of the raw materials (coal, char, coke, additives, etc.) is the primary requisite to optimize coke quality. This was the second year that complete evaluation analyses on coal and coke were performed.

In this fiscal year, a total of eight cost-recovery coal evaluation projects were performed, plus one CCRA research project.

Evaluation of Coal Blends by using Chemical and Oil-treated Coal Fines

Coal fines can generate dust problems during beneficiation, carbonization and transportation. Hoppers and bins may plug up when coal absorbs excess water; above all, coal fines are subject to oxidation due to their large surface area. Among the carbonization studies on blending of coal fines, one project on evaluating chemical and oil-treated coals showed generally positive results i.e. improved caking and coking properties and especially lower dust levels resulted from using oil-treated coals.

The Influence of Charging "High-Drop" and Moisture on Coking Parameters

At the request of a coal company, a project involving use of a high charge method was carried out; improved coke quality as measured by charge bulk density, coke strength and coke yield was observed.

Reproducibility of Coke-Oven Pressure Testing Program

Certain coals/coal blends expand during the coking cycle, causing pressure on the oven walls. If wall pressure exceeds tolerance limits, the oven will be damaged. A coal charge creating less than 2 psi (13.8 kPa) is assumed to be safe. However, with the development of fast-coking batteries of large capacity, the possibilities of pressure damage to the oven have increased. To ensure "standard specifications" for the test ovens in Edmonton and Ottawa, a number of coke oven tests were performed for this specific purpose. The results of these coking tests were presented during the CCRA technical committee meeting.

Support Analyses

Full coal/coke evaluation cannot be obtained without lab supporting analysis. Coal petrography and thermal rheological analysis were performed for each coke oven test.

COAL PREPARATION

Beneficiation of Fine Coal

Spirals

After completion of a study on the evaluation and application of spirals and water-only cyclones in cleaning fine coal, the report was distributed to coal preparation plant superintendents for future consideration to improve recovery of fine coal in their plants. Significant differences between the two density separators were specified in terms of applications and limitations that would help in selecting the circuit design which would achieve optimum recovery of fine coal.

The spiral has been installed in the 10tph pilot plant. This increases the versatility of the pilot plant from 13 to 17 flowsheet options. The system was successfully tested under continuous pilot plant operation.

Column Flotation

A 7.5m high and 0.76m diameter flotation column has been installed in the pilot plant. This increases the flowsheet options in the pilot plant from 17 to 20. Preliminary testing of the column is underway. Several options for generating fine air bubbles will be considered for testing in the near future. A proposal is being prepared to promote collaboration between coal companies on a testing program to evaluate existing operations (froth flotation) and the feasibility of using column flotation to improve fine coal recovery. The proposed work plan can be modified to meet the specific needs of each coal company.

Flotation Study

A bench scale study examined the effect of two types of clay on the flotation of four fine coal size fractions. Four reagents were used for the flotation tests. Results showed that the bentonite clay reduced the flotation efficiency more than expected by simple mass displacement. Kaolinite acted as a simple displacement. Surface tension studies failed to reveal a correlation between flotation efficiency and surface tension measurement. The effect of particle size on flotation efficiency is being evaluated. NMR/FTIR studies of the clay, coal and reagents were begun. Further work is required to examine the effect of oxidation of coal at different levels and to use FTIR to quantitatively determine the degree of oxidation.

Process Control Applications

Heavy Medium Control

The heavy medium cyclone process control microprocessor was interfaced with the mini-computer HP1000-A700. The evaluation of the system on pilot plant runs was successful. This installation is part of an overall program to use the pilot facilities to develop a comprehensive distributed control system and demonstrate its application to coal preparation.

Automated Start-up and Shut-down

The 10 tph pilot plant is extemely versatile and can be set up to run in twenty different flowsheet options to accomodate industrial and research needs. The software development for sequential start-up and shut-down on the Allen Bradley (AB) programmable logic controller Model PLC Z - 30 was completed. One advantage of such a system is the ease with which future modifications can be implemented.

On-line Monitoring Development

Both national and international reviews of process control development were used to guide CRL's plans in acquiring an on-line slurry ash monitor. This review will also assist in planning a field evaluation of an industry-installed unit to monitor clean coal quality over a belt conveyor. A study is also underway to evaluate and compare commercially available ash monitors.

Off-line Process Control Development

Graphical and numerical techniques were developed to optimize coal processing in parallel circuits where the product is a blend of washed coal and either middlings or raw coal. Optimization is carried out either relative to overall product mass flow rate or relative to yield subject to a specified product ash content. The proposed technique provides the coal preparation engineer with simple tools to adjust density separator cutpoints.

A numerical technique was developed to estimate the yield of density separators (two or three-product separation) based on the mass distribution of feed and products. The proposed technique is an alternative to the existing time-consuming methods based on ash content of feed and products.

A numerical algorithm was also developed to evaluate the sharpness of separation (probable error and error area) of density separators (two or three product separation). The proposed method is an alternative to graphical methods.

Porosimetry Computer Control Development

The automation of the high pressure section of the mercury porosimeter has been achieved by using a micro-computer and a data logging system. One of the benefits was the elimination of the need for an operator to collect results over a long period of time. The computer is also used to present collected data in a series of easy to understand graphic outputs.

A study of the pore structure of upgraded low-rank coals using mercury porosimetry revealed that the macropore structure can be described by a fractal dimension. Furthermore, this parameter appeared to be correlated with total pore volume and the amount of mercury trapped in the pores.

Deep Cleaning and Coal-Water Mixture Technology

Co-operative Work with the Federal Republic of Germany

This year the work has been focused on one activity instead of the original four. The area of interest was DENSECOAL slurry preparation and evaluation. Two phases of the work outlined below have been completed in cooperation with the Alberta Office of Coal Research and Technology.

Phase I: Beneficiation of fine coals from Alberta at the CRL facilities to produce 8% ash clean coal. The samples were tested by Salzgitter in Germany to select two coals best suited for dense coal slurry preparation and for further evaluation.

Phase II: Two bulk samples (60 tonne) from two mines were beneficiated at CRL's pilot plant and shipped to Germany for (DENSECOAL) slurry preparation and pipelining tests. The dense coal slurries were later shipped to Ottawa for combustion tests.

Phase III: One of the above two coals (or a blend) will be used to produce a 900 tonne lot of (DENSECOAL) slurry at the Victoria Junction (DEVCO, Sydney) facilities and then used for large scale combustion studies in Prince Edward Island. Engineering feasibility studies will be undertaken on slurry preparation, pipeline transportation and utilization.

Grinding Study

Eight coal samples from various Canadian mines with rank ranging from subbituminous to low volatile bituminous coals are being used for grinding and liberation studies. Grinding is performed in a bench scale ball mill. Coal samples are characterized before and after grinding. The amenability of different coals to deep cleaning is determined by washability studies before and after grinding. Results will be shared with coal companies and the experience gained will direct future pilot scale work.

Deep Cleaning Pilot Plant Installation

Phase I of the 2tph deep cleaning section of the pilot plant has been completed. It includes the expansion of floor space, installation of a ball mill, preparation tanks and supporting services. The installation was completed through a contract with a local engineering firm. Completion of CWM preparation section is planned for next year, in preparation for a cooperative program with a Canadian consulting company late in 1988.

SURFACE SCIENCE APPLICATION

This is a newly formed section applying surface science principles and techniques to problems relevant to industry and the provision of support for other units within CRL.

During 1987/88 extensive consultations were held with various industrial clients in the oil sands and coal industries. These consultations have led to collaborative research projects and have influenced the direction of in-house projects. Such projects include studies on the role of electrocoagulation in effluent treatment and the analysis of basic nitrogen in oil and its behaviour during upgrading processes.

In addition members of the section have contributed their expertise to projects which other units have undertaken.

Bruker Spectrospin (Canada) made available to CRL a new type of Michelson spectrometer whose design was partly based on suggestions published in a paper written by two section members. The extensive and

radical modifications necessary to convert a standard spectrometer to the novel step and integrate design were offered free of charge to the laboratory in exchange for access to our experimental results and experience. We regard this as a meaningful precedent which will lead to instrument designs more attuned to the needs of applied research laboratories such as ours.

Collaboration has also been initiated with members of the University of Alberta's Geology and Chemistry departments on matters of common interest. This collaboration is not based on any formal contract but rather on the University's perception of the advantages of a truly collaborative relationship with CRL in matters concerning the application of techniques and knowledge to practical problems faced by the fossil fuel and mining industries.

Fine Particle and Colloid Electrokinetics

Research concentrated on polymer adsorption and electrokinetics of coal in washery water. Particular problems in a coal washery were associated with the inhibition of flocculant; this study found the source of the inhibition to be humic acids. As a result of this work, in-house and contracted studies on residual polymer analysis were done in order to determine the excess active polymer that is recirculated in the washery water. Correlations with flocculation efficiency were obtained.

The electrokinetic and interfacial properties of clay organic complexes were studied. Standard clays are being used. Mechanisms of solid stabilized emulsions were investigated in relation to surface active components of bitumen emulsions.

Since the time between reagent addition and actual separation are variable under plant conditions, many systems are operating under non-equilibrium conditions. Both electrokinetic and surface electrochemistry were investigated in some coal systems to clarify the effect of non-equilibrium.

A review on the solvent effects on acid base equilibria was written. In addition, an automated titration system with novel characteristics was assembled and software written specifically to study these coals.

Flocculation

The secton's support role to the pilot plants and to the energy industry continued. In particular, the effectiveness of various polymers in promoting and hastening the flocculation of the thickener feed in several coal washing plants was tested. These tests were initiated by industry and involved extensive characterization of both the solids and the water.

A chemical manufacturer/supplier requested assistance in evaluating the quality of alum and proprietary polymeric flocculants. This is a continuing research project.

Infrared and Raman Spectroscopy

Fourier Transform Infrared (FT-IR) and Raman spectroscopy have been used to characterize solids derived from tar sand emulsions, low temperature ash samples obtained from eastern Canadian coals, a commercial fuel log, solids from heavy oil wastewater treatment, clays extracted from tar sands, asbestos samples, polymers optimized for flocculation, and frothers used in coal flotation. The interpretation of these spectra has been integrated with analysis of data obtained by other techniques.

The FT-IR spectroscopy system at CRL has been upgraded through the addition of a new computer and a new interferometer, the latter providing a unique opportunity for obtaining spectra corresponding to different depths within solid samples. After testing and evaluation of this equipment, it will be applied to a variety of cost recovery and internal research projects, e.g. surface oxidation of coal or the interaction of coals and oils used in agglomeration.

Thermal Analysis Techniques

The differential scanning calorimeter (DSC), thermogravimetric analyzer (TGA), and differential thermal analyzer (DTA) instruments were used extensively to study the interaction of clays with various organic chemicals. The focus of the study was the elucidation of the role of clays during extraction of bitumen from oil sands. The work, undertaken at the request of Syncrude Research, is aimed at characterizing the various

clay-organic complexes appearing at different stages of the process. This is an ongoing investigation.

Also ongoing are studies elucidating the energetics of clay or coal particle interaction with flocculants. A better understanding of the flocculation and agglomeration processes is emerging. The possible economic impact of these studies is significant since large sums are expended yearly to promote settling in water cleaning operations associated with most oil or coal processing plants.

ENGINEERING AND FIELD DEMONSTRATION

Heavy Oil/Bitumen Emulsion Treatment Mini-Plant

The work related to the treatment of emulsions is carried out at various experimental scales including a 70 bpd mini-plant. The scope of this is unique and covers the entire spectrum of the treatment foremulsions arising from produced heavy oil and produced water. It includes oil-water separation equipment such as free water knockout, dual-polarity electrostatic treater, evaporation dehydrator, induced gas flotation, etc. The equipment is arranged to allow maximum flowsheet flexibility and comprehensive sampling for material balance.

The commissioning of the heavy oil mini-plant was completed at the end of fiscal year 1987/88. Preliminary testing will commence in the new fiscal year.

Mobile Water Treatment Plant

The mobile water treatment plant was used during a co-operative test program between FPL and a coal washing plant.

The objective of this test program was to optimize the performance of solid bowl centrifuges used for dewatering the washery's fine reject and improve the performance of the washery dewatering circuit. This area was identified by the operators as the most urgent and high-cost in their process. The centrifuge on the mobile unit was employed to evaluate the machine variables, the effect of flocculant addition, feed rate, and feed solids content on the dewatering of plant tailings.

Mobile Dewatering Plants

The mobile dewatering plants were field tested at CNRL Line Creek coal washing plant. The field testing concentrated on calibration of new on-line monitors, debugging and mechanical optimization of the dewatering plant and testing of the belt filter press with washery feed. Tests with the mobile plant belt filter press were conducted in parallel with washery belt presses. The experimental design included machine variables such as belt tension, belt speed and retention time and process variables such as flocculant dosage, feed rate, and feed solids concentration.

Pretreatment of Produced Water

A cooperative test program with the Wastewater Technology Centre of Environment Canada was set up to investigate the filterability of the sludge produced by pretreatment of produced water from Murphy Oil's site at Lindbergh, Alberta. This program was supported from funds for the on-going Industry-Government Produced Water Treatment Project.

The overall objective of the test program is to determine a cost-effective method for dewatering the produced sludge. Bench scale tests were designed to evaluate the suitability of the dewatering methods. The experimental work was divided into three phases: The first phase included the evaluation of various flocculants for feed conditioning and the generation of data on the suitability of pressure filters (belt filters) using capillary suction time filtration apparatus. The second phase focussed on vacuum filtration test work to simulate the performance of a horizontal surface continuous vacuum filter (belt, pan and table). The filter leaf test data helps to predict whether a rotary drum or disc filter is suitable for the application. The final phase of experimental work was focussed on centrifugation using a frozen image centrifuge to predict whether a (solid bowl) centrifuge was suitable.

OIL EMULSION

This section is intensively involved both in collaborative cost-recovery industrial research and in laboratory-based fundamental

support studies. These latter studies are based on industry needs and problems as determined by continuous consultation with a wide range of industry representatives and plant site visits by research scientists.

Activity was by no means limited to oil emulsions or even to oil/tar sands systems. During the 1987/88 FY, activities in the laboratory included areas such as oxidation and weathering of stockpiled coal and related effects on flotation/beneficiation/coking properties, correlations of mineral composition to tar sands processability, char evaluation, characterization pitches, study of oil sands tailings pond emulsions, demulsifier identification, modification, testing (in-house and field) and characterization of heavy oil natural surfactants. The success of this cooperative multi-disciplinary research to solve practical industry problems has attracted considerable industrial as well as national and international recognition to CRL. Extensive contacts have been made with heavy oil and coal processors, chemical manufacturers and intermediate business (i.e. suppliers of chemicals to the industries in question). Cost recovery effort comprised the majority of the group's efforts and resulted in about 20 confidential reports.

The Microstructure Laboratory

The techniques available in the microstructure laboratory, including scanning electron microscopy, mercury porosimetry, surface area measurements and gas sorption/desorption (ΔP) studies, have been used in the on-going study of coal weathering/oxidation and low rank coal upgrading. Coal oxidation impacts on many aspects of both coal beneficiation and utilization, including froth flotation, coking properties, and coal dustiness. The commercialization of the ΔP instrument developed at CRL is a clear example of technology transfer to industry.

The cryogenic capability of the scanning electron microscope has been further developed and utilized in several projects concerning oil sands emulsions. Morphological studies and the x-ray fluorescence analysis capabilities allow the determination of emulsion structure and composition, as well as of the interfacial region primarily responsible for determining the overall emulsion stability. In-house work has been directed at

optimizing this latter technique and several publications in the refereed literature have resulted. The success of these microscopic/image analysis projects has resulted in considerable interest among industrial (cost-recovery) clients in acquiring their own systems for process and quality control in consultation with group staff members. Microscopic studies of emulsion aging effects have also been undertaken to ensure that both fresh and aged emulsion behaviour are fully understood in the context of all related in-house studies.

Nuclear Magnetic Resonance Spectroscopy

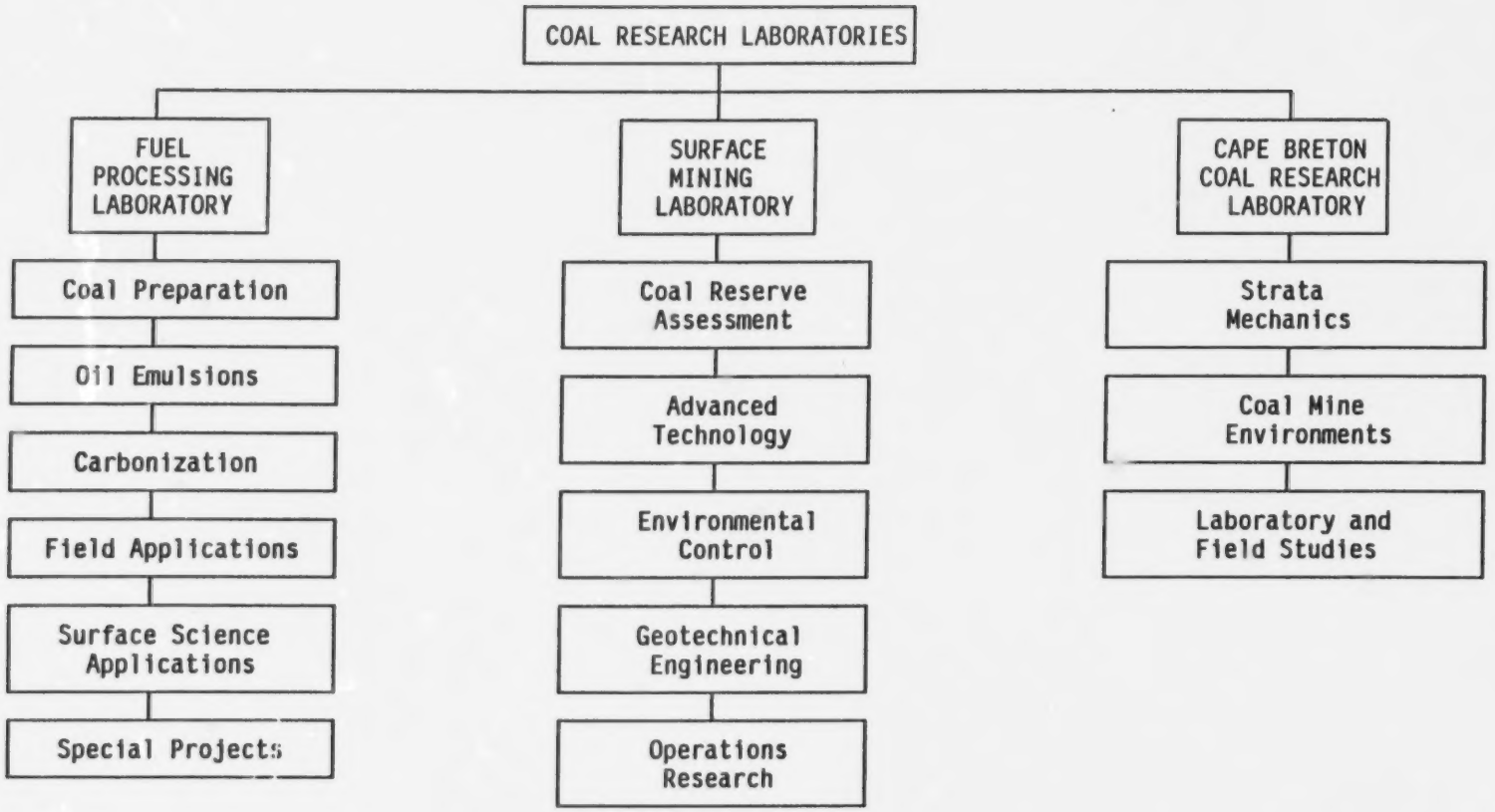
NMR has been applied extensively to the study of fossil fuels and polymers. Fundamental and applied studies involve low rank coal upgrading processes, natural and low temperature (laboratory) oxidation and weathering, maceral characterization and relationship to whole coal properties, and a survey of functional group distribution in coals as a function of rank. Polymer applications include flocculation and demulsification mechanisms, polymer characterization (lot-to-lot variations) and thermal stability. Charge density and charge distribution of flocculants and demulsifiers are correlated with field determined efficiencies. Other research involves the relationship of clay mineral composition with flocculation processes in washeries, characterization of insoluble organic carbon associated with clay minerals, heavy metal minerals in oil emulsion treatment and heavy oil upgrading processes. In collaboration with the industry, a comprehensive understanding of the origin of stable water-in-oil emulsions in refined oil sands plant products has been developed.

Optical Microscopy

As noted, industrial applications of image analysis in general and optical microscopy in particular, have been exceptionally well developed during the year, with the main focus on industry-supplied water-in-oil and oil-in-water emulsions. Observation of selective wax deposition/crystallization in crude oils by variable temperature/fluorescence microscopy has been undertaken. Optimization of the Cambridge Quantimet image analyzer has been undertaken to provide quantitative analysis of submicron particles.

Correlations between particle size, and the effect of caustic and demulsifier concentration have been investigated to support optimization of heavy oil/tar sands upgrading processes. Particle size analyses, ion chromatography, gas/liquid chromatography, interfacial tension, contact angle, Dean and Stark analyses and moisture meter measurements were indispensable components of all programs noted. The development of polarized light techniques has resulted in a greatly increased understanding of the mechanisms of pitch and coke formation during the liquefaction of coal and on heavy oil/tar sands systems.

APPENDIX A: THE ORGANIZATION OF THE COAL RESEARCH LABORATORIES


COAL RESEARCH LABORATORIES
FUEL PROCESSING LABORATORY
Coal Preparation
Oil Emulsions
Carbonization
Field Applications
Surface Science Applications
Special Projects
SURFACE MINING LABORATORY
Coal Reserve Assessment
Advanced Technology
Environmental Control
Geotechnical Engineering
Operations Research
CAPE BRETON COAL RESEARCH LABORATORY
Strata Mechanics
Coal Mine Environments
Laboratory and Field Studies

APPENDIX B: RESOURCES

RESOURCES

The 1987/88 activities of Coal Research Laboratories were carried out under both the Fuels Technology and Coal Mining and Preparation sub-activities of the Mineral and Earth Sciences Program. The resources allocated to the division were distributed as shown below:

	Staff Level (PY)	Budget Operating $000's	Capital $000's
Bitumen/Emulsion Treatment	5	290	168
Coal Preparation	13	365	319
Coal Desulphurization	-	78	-
Carbonization	5	50	10
Coal Reserve Assessment	4	15	0
Coal Mining: East	11	277	183
Coal Mining: West	12	225	217
Management & Support	11	271	20

These resources were distributed across three operating laboratories:

Devon : Fuel Processing
Devon : Surface Mining
Cape Breton : Underground Mining
Devon : Administration

APPENDIX C: PROFESSIONAL, TECHNICAL AND ADMINISTRATIVE STAFF

PROFESSIONAL, TECHNICAL AND SUPPORT STAFF

Name	Degrees and Diplomas	
T.D. Brown	B.Sc., (Durham), Ph.D. (Sheffield) C.Eng.	Director
S.D. Ludwar		Secretary
ADMINISTRATION		
C.F. Cameron		Admin.Officer
C.B. Ripper		Clerk
V. Keim		Clerk
J. Young		Clerk
S. Iwaskow		Clerk
J.I. MacDonald		Clerk
B. Bresson		Clerk
COAL MINING RESEARCH		
D.B. Stewart	B.Sc., M.Sc., (Queen's), P.Eng.	Manager
H. Brown		Secretary
CAPE BRETON		
G.A. Haslett	B.Sc., (Durham), C.Eng.,P.Eng.	Group Leader
C. Spitieris		Secretary
Strata Mechanics		
T.R.C. Aston	B.Sc., (Cardiff), Ph.D., (Nottingham) P.Eng.	Res. Sci.

Coal Mine Environments

B.W. Konda	B.Eng., (Hyderabad), Ph.D., (Nottingham)	Phys. Sci.
J.C.Y. Hwang	B.Sc., (Taiwan), M.Sc.,(Central) M.Sc., Ph.D. (McGill)	Res. Sci.
D.J. Kennedy	B.Sc., (Windsor)	Phys. Sci.
G.W. Klinowski	M.Sc., (Silesian Tech.)	Engineer

Laboratory and Field Testing

G.W. Bonnell	B.Sc., (Dalhousie)	Chemist
C. MacNeil		CS
W.D. Gallant		EG-ESS
D.J. O'Brien		EG-ESS
D.A. Young		EG-ESS
G.R. Corbett		EG-ESS
L.S. O'Leary		EG-ESS

SURFACE MINING LABORATORY (Devon, Alberta)

Advanced Technology

G. Zahary	B.Sc.,(Alberta), M.Eng.,(McGill), P.Eng. (On secondment to Program Office)	Phys.Sci.
R.K. Singhal	B.Sc., (Nottingham), Ph.D.,(Newcastle-on-Tyne), C.Eng., P.Eng.	Phys.Sci.
H.G. Naidu	B.Sc., A.I.S.M. (Indian School of Mines) P.Eng.	Engineer

Environmental Control

R.N. Chakravorty	B.Ch.E. (Jadavpur), Ph.D., (Nottingham)	Res.Sci.
N.A. Mansour	B.Sc. (Ain-Shams), B.Sc., Ph.D.(Alberta)	Res.Sci.

Geotechnical Engineering

B. Das	B.Sc., A.I.S.M. (Indian School of Mines) Ph.D., (Ostrava), P.Eng.	Res.Sci.
A. Stokes	B.Sc., Ph.D., (Nottingham).	Res.Sci.

Laboratory and Field Services

G.H. Larocque		EG-ESS
K.L. Kar		EG-ESS

Operations Research

V. Srajer	Dipl. Eng., M.Sc.(Kosice), Ph.D. (Nottingham), P.Eng.	Engineer
J. Szymanski	M.Sc., Ph.D., (Wroclaw)	Res.Sci.
R.J. Kolada	B.Sc., Ph.D., (Nottingham)	Res.Sci.
N.J. Stuart	B.Sc., Ph.D., (Nottingham)	Res.Sci.

Coal Reserve Assessment (Ottawa)

A.S. Romaniuk	B.Sc.,(Queen's), P.Eng.	Phys.Sci.

FUEL PROCESSING LABORATORIES (DEVON)

H.A. Hamza	B.Sc.,(Cairo), Ph.D., (Newcastle-on-Tyne)	Manager
V. Marshman		Secretary
D. Caron		Secretary

Oil Emulsions

R. Mikula	B.Sc.,(Saskatchewan), Ph.D.,(British Columbia)	Res.Sci.
D. Axelson	B.Sc., Ph.D., (Toronto)	Res. Sci.
Y. Theriault	B.Sc., M.Sc., Ph.D., (Alberta)	Res.Sci.
V. Munoz	B.Sc., (U of Chile)	Phys.Sci.
W. Lam	B.Sc., (Western Ontario),Ph.D.(Alberta)	P.D.F.

Carbonization

A.B. Fung	B.Sc., (Waterloo), P.Eng.	Engineer
R. Zrobok	B.Sc., (Alberta)	Phys.Sci.
K. McAuley		GL-MOC

Engineering and Field Demonstration

K. Hashmi	B.Sc. (Alberta), P.Eng.	Engineer
Z. Potoczny	B.Sc., M.Sc. (Toronto), P.Eng.	Engineer
M. Hewlett		EG-ESS

Surface Science Applications

J.C. Donini	B.Sc., (Western Australia) Ph.D., (York)	Res.Sci.
K. Michaelian	B.Sc., (California), Ph.D.(Simon Fraser)	Res.Sci.
C. Angle	B.Sc., (Alberta)	Phys. Sci.
W.F. Mo	B.Sc., (Alberta)	Phys.Sci.
R.G. Frenette	B.Sc., (Santo Thomas)	EG-ESS
S. Kelebek	B.Sc.(Istanbul), M.Eng.(McGill), Ph.D., (McGill)	PDF
K. Kasperski	B.Sc., (Lethbridge), M.Sc.(McGill), Ph.D., (Alberta)	PDF

Special Projects

N.E. Andersen	B.Sc., (Alberta)	Phys.Sci.
D. Vercammen	C.E.T. (SAIT)	EG-ESS

Coal Preparation

M.W. Mikhail	B.Sc., (Assuit), M.Sc.,(Alberta),P.Eng.	Engineer
W.I. Friesen	B. Sc., (Brock), Ph.D., (British Columbia)	Res.Sci.

Coal Preparation - Cont'

A.I. Salama	B.Sc., (Alexandria), Ph.D., (Alberta)	Res.Sci.
I. Parsons	B.Sc. (Western Ontario)	Phys.Sci.
O. Humeniuk		EG-ESS

STAFF CHANGES

NEW EMPLOYEES

Dr. J.C. Donini
A.B. Kempe
D. Caron
Dr. S. Kelebek (PDF)
Dr. W. Kam (PDF)
D. Vercammen
Dr. K. Kasperski (PDF)

RESIGNATIONS AND SEPARATIONS

J. Picard
Dr. P. Cain
Dr. Z. Shu
G. Zuber
S. Twa
A.B. Kempe
W. Silbernagel

APPENDIX D: PUBLICATIONS, PRESENTATIONS AND PATENTS

PUBLICATIONS, PRESENTATIONS, PATENTS, BOOKS

BOOKS

Singhal, R.K., Co-Editor, Computer Applications in the Mineral Industry: Proceedings of the First Canadian Conference on Computer Applications in the Mineral Industry, Université Laval, Canada, March 7-9, 1988. A.A. Balkema, Amsterdam, 1988.

CONTRIBUTION TO BOOKS

Axelson, D.E. "Detection of Mobile Components in the Solid State NMR of Coals". Chapter 8 in NMR of Humic Substances and Coal, Lewis Publishers, 1987.

Leung, W.M. Axelson, D.E. and Syme, D. " Flocculation Behaviour of Imidized and Hydrolyzed Polyacrylamides". International Symposium on Flocculation in Biotechnology and Separation Systems, San Francisco, July 2 - August 2, 1986, in press.

PATENTS

Mikula, R.J., Mikhail, M.W., Dean, D.W. and Savage, J.D., "ΔP Instrument for Oxidation Measurement", US Patent No. 4,671,098.

JOURNAL PUBLICATIONS

Aston, T.R.C., Tammemagi, H.Y. and Poon, A.W. " A Review and Evaluation of Empirical and Analytical Subsidence Prediction Techniques"; Mining Science and Technology Journal, vol 5, No. 1, pp 59-69; May 1987.

Axelson, D.E. "Al-27 and Sc-29 Solid State Nuclear Magnetic Resonance of Coal and Heavy Oil-Derived Mineral Matter". Fuel Sci. Tech. International, 561-592 (1987).

Axelson, D.E. "Solid State Carbon-13 Nuclear Magnetic Resonance of Heavy Oil/Bitumen-Derived Solids". Fuel, 66, 40-43 (1987).

Axelson, D.E. "Spinning Sideband Suppression and Quantitative Analysis in Solid State NMR of Fossil Fuels". Fuel, 66, 195-199 (1987).

Axelson, D.E. "Solid State Carbon-13 NMR Study of Canadian Coals". Fuel Proc. Tech., 16, 257-278 (1987).

Chakravorty, R.N., "Bacteria Makes Mine Safe", New Biotech, Volume 1, No. 7, March, 1987.

Friesen, W.I. and Mikula, R.J. "Fractal Dimensions of Coal Particles", J. Colloid Interface Sci. 120. pp. 263-271; 1987..

Forrester, D.J. and Aston, T.R.C. "A Review of Mining Subsidence Instrumentation and its Potential Application for Seabed Monitoring"; Mining Science and Technology Journal, vol 4, No. 3, pp 225-240; March 1987.

Kolada, R.J., Muirhead, I.R., "A Review of Unconventional Coal Mining Concepts with Potential for Application in Western Canada". Bulletin of the Canadian Institute of Mining and Metallurgy; January, 1988.

Leung, W.M., Axelson, D.E. and VanDyke, J. "Thermal Degradation of Polyacrylamide and Poly(Acrylamide-Co-Acrylate)". J.Polym, Sci., Polym. Chem Ed., 25, 1825-1846 (1987).

Mansour, N., Szymanski, J.K., "Novel Instrument for Monitoring Stability of Coal Water Fuel"; Journal of Fuel Science and Technology International, Volume 5, No. 2, 1987.

Mansour, N.A., "Electromagnetic Sensor for the Measurement of Dispersed Phase Concentration in Coal Liquid and Alternate Fuel Dispersions; J. Coal Quality, January, 1987.

Mansour, N.A., Tinga, W.R., "A Generalized Non-Linear Theory for One-Port Microwave Active Circuits"; IEE Proceedings, Volume 134, Pt. H., No. 5, pp. 411-416, October, 1987.

Mansour, N.A., Tinga, W.R., "Non-Linear Modelling Applied to One-Port Microwave Active Circuits; IEE Proceedings, Volume 134, Pt. H., No. 5, pp. 417-422, October, 1987.

Michaelian, K.H., Bukka, K. and Perman, D.N.S. "Photoacoustic Infrared Spectra (250 cm^{-1} -10,000 cm^{-1}) of Partially Deuterated Kaolinite #9". Canadian Journal of Chemistry 65, 1420 (1987).

Michaelian, K.H. "Signal Averaging of Photoacoustic FTIR Data I. Computation of Spectra from Double-Sided Low Resolution Interferograms". Infrared Physics 27, 287 (1987).

Mikula, R.J. and Mikhail, M.W., "A ΔP Technique for the Prediction and Monitoring of Coal Oxidation", Coal Preparation, A Multinational Journal, Vol. 5, pp. 57-69; 1987.

Mikula, R.J. "Application of X-Ray Microanalysis to Tar Sands Emulsions". Colloids & Surfaces, Vol. 23 (1987) pp. 267-271.

Naidu, H.G., Singhal, R.K., Clausen, G., Currie, J.A., "The Potential For Cast Blasting in Canadian Surface Mines"; International Journal of Surface Mining, Volume 4.

Salama, A.I.A. and Mikhail, M.W., "Coal Preparation Process Control R & D." Proceedings of the First Canadian Conference on Computer Applications in the Mineral Industry, March 7-9, 1988.

Salama, A.I.A. "Evaluation of the Performance of Density Separators" The International Journal of Coal Preparation, Vol. 5, pp 121-127; 1987.

Salama, A.I.A.and Mikhail, M.W. "Analysis of Coal and Mineral Processing Circuits, Signal Flowgraph Approach", The Bulletin of the Canadian Institute of Mining and Metallurgy (CIM), Vol. 80, No. 901, pp. 51-53; 1987.

Shu, J.S. and Michaelian, K.H. "Surface Enhanced Raman Scattering as a Probe of Surface Geometry Effects on the Polymerization of Acrylic Acid On Silver". Journal of Physical Chemistry 91, 598 (1987)

Shu, J.S. and Michaelian, K.H. "Surface Enhanced Raman Spectroscopy of Acrylamide and Polyacrylamide Adsorbed on Silver Colloid Surfaces: Polymerization of Acrylamide on Silver". Journal of Raman Spectroscopy 18, 4409 (1987).

Singhal, R.K., Collins, J.L., Fytas, K., "Design, Construction and Maintenance of Surface Mine Haulage Roads". International Journal of Surface Mining, Volume 1, Number 2, 1987.

Singhal, R.K., Kolada, R.J., "Surface Mining of Oilsands in Canada: Developments in Productivity Improvement"; Mining Engineering, pp. 267-270, April, 1987.

Singhal, R.K., Fytas, K., "Computer Program Matches Trucks with Shovels". Coal Age, May, 1987.

Singhal, R.K., Stewart, D.B., Bacharach, J.P.L., "Frictional Ignition Control"; Colliery Guardian, May, 1987.

Singhal, R.K., "How to Choose Surface Mining Software"; Engineering and Mining Journal, June 1987.

Singhal, R.K., Golosinski, T.S., "Basic Considerations in Selection of Bucketwheel Excavators"; International Journal of Surface Mining, Volume 1, No. 1, 1987 (June).

Singhal, R.K., Fytas, K., Collins, J.L., "Open Pit Trends 1986"; International Mining, August, 1987.

Singhal, R.K., et al. "Recent Developments in Material Transportation Systems for Surface Mining"; The Indian and Eastern Engineer, 128th Anniversary Number, August, 1987.

Singhal, R.K., "New Technology for Large Surface Mines. Engineering & Mining Journal, September, 1987.

Singhal, R.K., "Underground Coal Mining - Methods, Equipment, Developments and Trends"; International Mining, December, 1987.

Stokes, A.W., Kennedy, D.J., and Hardcastle, S.G. "A Real Time Gas Analyzer - An Investigational Tool for Mine Ventilation Studies"; Mining Science and Technology Journal, vol 5, No. 2, pp 187-196; July 1987.

CONFERENCE PROCEEDINGS AND PRESENTATIONS

Angle, C.W. "The Effect of Selected Polymers on the Electrokinetic Properties of Fine Coal Particles and Silica in Washery Water". Presentation made to University of Alberta, Mineral Engineering Department, January, 1988.

Axelson, D.E. "Clay-Organic Complexes and Oil Sands Processability". CIM Conference, Ft. McMurray, Alberta, September, 1987.

Axelson, D.E. "Solid State NMR Relaxation Study of Coals". Regional ACS Meeting, Chicago, June, 1987.

Axelson, D.E., Mikula, R.J. and Munoz, V.A. "Characterization of Coal Oxidation In-Situ and on a Stockpile". 1987 Int'l Conference on Coal Science, Netherlands, Sept. 1987.

Bachelor, F., Majumder, A., Buckmaster, H., Duczal, T., Chakravorty, R.N., "A Study of the Thermal Response, Peroxygen and Free Radical Content of Western Canadian Coals when Treated with Moist Air and Nitrogen - A Model for Spontaneous Combustion Evaluation; Proceedings of the 1987 International Conference on Coal Science, Maastricht, The Netherlands, October 26-30, 1987.

Cain, P., Stokes, A.W., "Monolithic Packing in the Undersea Coalfields of Cape Breton, Nova Scotia"; Mining Engineer, October, 1987, pp. 168-174, Volume 147, No. 313.

Chakravorty, R.N., Kolada, R.J., "Recent Developments in the Prevention and Control of Spontaneous Combustion in Coal Mining Operations"; 117th Annual Meeting of Society of Mining Engineers, Pheonix, Arizona, January, 1988.

Chakravorty, R.N., Lanteigne, R., Forrester, P.I., "Methane Control During Shipments of Coal; Ninth International Symposium on the Transport and Handling of Dangerous Goods by Sea and Inland Waterways; Rotterdam, The Netherlands, April 1987.

Das, B., Serata, S., Nikols, D.J., "Application of the Stress-Property-Deformation Relation (SPDR) Integrated Method to the Surface Mine Slope Stability Problem"; Presented to the 89th AGM of the Canadian Institute of Mining and Metallurgy, Toronto, May 3-7, 1987, Preprint No. 159.

Das, B., Janakiraman, C., "Numerical Modelling Application to Rock Mechanics on a Super Computer"; Presented Proc. of the 28th U.S. Symposium on Rock Mechanics, Tucson, Arizona, June 29 - July 1, 1987, pp. 735-743.

Friesen, W.I. and Mikula, R.J., "Characterization of Upgraded Low-Rank Coal by Fractal Dimension", 1987 International Conference on Coal Science (Elsevier, Amsterdam, 1987) pp. 929-932.

Friesen, W.I. "Simulated Measurements of Pore Size Distributions in Random Pore Structures", 61st Colloid and Surface Science Symposium of the American Chemical Society, Ann Arbor, June 1987.

Friesen, W.I. "The Pore Structure of Coal - Fun with Fractals and Percolation Theory", Department of Physics, U. of British Columbia, April 1987.

Friesen, W.I. "Pore Structure of Coal - Applications of Fractals and Percolation Theory", CANMET Energy Research Laboratories, Ottawa, May 1987.

Gilby, J.L., Yuen, C.M.K. and Aston, T.R.C. "Geotechnical Monitoring of Tunnel Boring Machine Drivages at the Donkin-Morien Mine, Nova Scotia"; 89th CIMM AGM; May 3-7, 1987; Toronto, Canada.

Gould, G.B., McConechy, B., Srajer, V., "Equipment Performance Monitoring"; First Canadian Conference on Computer Applications in the Mineral Industry, Quebec City, Quebec, March 7-9, 1988.

Hashmi, K.A. "Dewatering of Coal Tailings Using Belt Filter Press - Results from Field Test at CNRL Line Creek". Presented to CNRL operators at Line Creek, May 1987.

Hashmi, K.A. "Dewatering of Sludge Produced from the Pretreatment of Produced Water Treatment". A review meeting presenting the results and status of the project, Burlington, February 21, 1988.

Janakiraman, C., Das, B., "Application of Artificial Intelligence and Robotics to Mining"; Proc. of the Second International Conference on Robotics and Factories of the Future, San Diego, July 28-31, 1987.

Kennedy, D., Stokes, A.W., Klinowski, G., Resolving Complex Mine Ventilation Problems with Multiple Tracers"; Published in the Proceedings of the 4th U.S. Mine Ventilation Symposium, Pennsylvania State University, Pittsburgh, October, 1987.

Kolada, R.J., Chakravorty, R.N., "Controlling the Hazard of Methane Explosions in Coal Storage Facilities", Fourth U.S. Mine Ventilation Symposium, Pennsylvania State University, Pittsburgh, October, 1987.

Konda, B.W. and Cecala, A.B. "Measuring Methane Flow Patterns on Advancing Longwall Panels"; Third Mine Ventilation Symposium, October 12-14, 1987; The Pennsylvania State University.

Krakiwsky, K, Kempe, A.B., Srajer, V., Stuart, N.J., Kolada, R.J., "An Automatic Vehicle Location System for Surface Mines". First Canadian Conference on Computer Applications in the Mineral Industry, Quebec City, Quebec, March 7-9, 1988.

Levine, S. and Friesen, W.I. "A Study of Electrostatic Breaking of Water-in-Oil Emulsions", 61st Colloid and Surface Science Symposium of the American Chemical Society, Ann Arbor, June 1987.

Mansour, N.A., "Concentration Measurements in Emulsions; International Power Institute"; 22nd International Microwave Power Symposium, August 31- September 2, 1987.

Michaelian, K.H., "Photoacoustic FT-IR Spectroscopy of Clay Minerals and Coals". Presented at the Ames Laboratory, Iowa State University, November, 1987.

Michaelian, K.H., "Phase Correction of Photoacoustic FT-IR Spectra". Presented at Sixth International Conference on FT Spectroscopy, Vienna, August, 1987.

Mikula, R.J. "Application of Scanning Electron Microscopy to Tar Sands Emulsions". Proceedings to the Thirteenth Annual Meeting of the Microscopical Society of Canada, 1986, pp.40.

Mikula, R.J. "Application of X-Ray Microanalysis to Tar Sands Emulsions". Proceedings of the Eleventh International Conference on X-Ray Optics and Microanalysis.

Naidu, H.G., Singhal, R.K., "Experience with Cast Blasting in Canadian Surface Coal Mines"; 4th Annual Conference on Explosive and Blasting Technique, January 31 - February 5, 1988, Anaheim, CA, U.S.A.

Singhal, R.K., Fytas, K., Collins, J.L., "Productivity Enhancements in Canadian Hard Rock Surface Mining"; Society of Mining Engineers Annual Meeting, Denver, February 24-27, 1987. Preprint 87-93.

Singhal, R.K., Fytas, K., Collins, J.L., "Potential Applications of Knowledge Based Systems in Mining"; 89th Annual General Meeting, Canadian Institute of Mining & Metallurgy, May, 1987.

Singhal, R.K., Sahay, H., Ghosh, S., "Continuous Mining Systems for Oil Sands Mining. 13th World Mining Congress, Stockholm, Sweden, June, 1987.

Singhal, R.K., et al, "Western Canadian Surface Mining Technology"; Proceedings Second Canadian Symposium on Mining Automation (Developments in Mechanization, Monitoring, and Controls), Sudbury, Ontario, October 20-22, 1987.

Singhal, R.K., "Recent Developments in Mechanization in Underground Coal Mining"; Proceedings Second Canadian Symposium on Mining Automation (Developments in Mechanization, Monitoring and Controls), Sudbury, Ontario, October 20-22, 1987.

Singhal, R.K., "Predesign Considerations of Waste Dumps in Western Canadian Surface Mines"; Proceedings Conference on Applied Rock Engineering (CARE '88) Conference. Institution of Mining and Metallurgy, Newcastle Upon Tyne, United Kingdom. January, 1988.

Singhal, R.K., Naidu, H.G., Singh, S.P., "Influence of Blasting on Open Pit Economics"; Society of Mining Engineering Annual Meeting. Phoenix, Arizona, January 25-28, 1988.

Singhal, R.K., Cavers, D.S., "Three Hinge Beam Analysis for Buckling of Stratified Rock Strata"; Proceedings of the First Canadian Conference on Computer Applications in the Mineral Industry, University of Laval, March 7-9, 1988.

Singhal, R.K., Sturgul, John, "Using the Personal Computer to Simulate Mining Operations"; Proceedings of the First Canadian Conference on Computer Applications in the Mineral Industry. University of Laval, March 7-9, 1988.

Stokes, A.W. and Kennedy, D.J. "Tracer Gas Techniques for Precise Mine Ventilation Measurements"; 22nd International Conference of Safety in Mines Research Institute; November 1987; Beijing, China.

Stuart, N.J., Cobb, Q., "Two Approaches to the Computerized Planning of Dragline Operations"; 1st Canadian Conference on Computer Applications in the Mineral Industry, Quebec City, Quebec, March, 1988.

Szymanski, J.K., Stuart, N.J., "Software for the Numerical Evaluation of Conveyor Lengths as a Function of Installed Power"; 1st Canadian Conference on Computer Applications in the Mineral Industry, Quebec City, Quebec, March, 1988.

Yuen, C.M.K., Boyd, J.M. and Aston, T.R.C. "Rock-Support Interaction Study of a TBM Driven Tunnel at the Donkin Mine, Nova Scotia"; 6th International Congress on Rock Mechanics; August 30 - September 3, 1987; Montreal, Canada; vol 2, pp. 1339-1344.

UNPUBLISHED PRESENTATIONS

Aston, T.R.C. "Monitoring Seafloor Subsidence Profiles over Longwall Mining Operations in the Sydney Coalfield, N.S."; Presented at:
- The Dept. of Mining and Metallurgical Enginnering, McGill University; February 17, 1987.
- The Pacific Geoscience Centre, Sidney, B.C.; April 1, 1987.

Aston, T.R.C. "Geotechnical Monitoring of Tunnel Boring Machine and Drill and Blast Drivages at the Donkin-Morien Mine, Sydney Coalfield, Nova Scotia"; Presented at:
- The Dept. of Mining and Metallurgical Engineering, McGill University; February 24, 1987.
- The School of Engineering, Laurential University; February 27, 1987.
- The Centre de Recherche Noranda, Pointe Claire, P.Q.; March 2, 1987.
- The Dept. of Earth Sciences, Memorial University of Newfoundland; March 11, 1987.
- The Dept. of Mining Engineering, Technical University of Nova Scotia, Halifax; March 13, 1987.
- The Geotechnical Research Centre, University of Western Ontario; March 16, 1987.
- The Dept. of Earth Sciences, University of Waterloo; March 17, 1987.
- The Dept. of Civil Engineering, University of Toronto; March 18, 1987.
- The Dept. of Mining Engineering, Queen's University; March 19, 1987.
- The Dept. of Geological Engineering, University of Manitoba; March 23, 1987.
- The Dept. of Geological Sciences, University of Saskatchewan; March 24, 1987.
- The Tunnelling Association of Canada (TAC), Edmonton Branch; March 26, 1987.
- The Dept. of Civil Engineering, University of Alberta; March 26, 1987.
- The Dept. of Civil Engineering, University of Calgary; March 30, 1987.
- The Dept. of Mining and Mineral Process Engineering, University of British Columbia; March 31, 1987.
- The Cape Breton Geological Society, University College of Cape Breton; April 7, 1987.
- The USBM Research Centre, Pittsburgh, Pa.; June 22, 1987.

Aston, T.R.C. "Hydrogeological Aspects Associated with British Ironstone Mining"; Presented to the Cape Breton Geological Society, University College of Cape Breton; December 2, 1987.

Bétournay, M. and Aston, T.R.C. "Suivie Géotechnique des Avances par Tunnellier et par Forage et Sautage à la Mine Donkin-Morien, Bassin Houiller de Sydney, Nouvelle-Écosse"; Présenté au:
- Centre d'Études sur les Ressources Minérales, Université du Québec à Chicoutimi; 19 Février 1987.
- Dépt. Mines et Métallurgie, Université Laval; 20 Février 1987.
- Dépt. de Génie minéral, École Polytechnique; 25 Février 1987.

Janakiraman, C., Das, B., Nikols, J.D., "Supercomputers in Mining Research and Development"; Unpublished presentation to the Supercomputing Symposium '87; The University of Calgary, June 15-16, 1987.

Janakiraman, C., Das, B., Nikols, J.D., "Slope Problem on a Supercomputer". Unpublished presentation to the Supercomputing Symposium '87; The University of Calgary, June 15-16, 1987.

Rottenfuser, B., Stokes, A.W., "Geology and Geotechnical Monitoring at the AOSTRA UTF", Presented at the CIM District Five Meeting, September 16-19, 1987, Fort McMurray, Alberta.

Stokes, A.W., "Recent Research Activities of the Cape Breton Coal Research Laboratory". Given to the Lynn Lake Branch of the Manitoba CIM, April, 1987.

Stuart, N.J., "Knowledge Based Programming and the Truck Dispatch Problem". Presentation given as lecture at McGill University in Montreal and Laval University in Quebec City, September, 1987.

CANMET REPORTS

87-3E	Coal Mining in Canada: 1986	A.S. Romaniuk H.G. Naidu

DIVISIONAL REPORTS

UNCLASSIFIED

ERP/CRL 86-34(OP,J)	Application of Scanning Electron Microscopy to Tar Sands Emulsions	R.J. Mikula
ERP/CRL 86-95(J)	A Real-Time Gas Analyzer: An Investigational Tool for Mine Ventilation Studies	A.W. Stokes S.G. Hardcastle D.J. Kennedy
ERP/CRL 86-157(TR)	Sensitivity Analysis of Production and Power Consumption Using a Computer Based Bucket Wheel Excavator-Conveyor-Bin Model	J.K. Szymanski
ERP/CRL 87-9(OP)	Some Remarks on the Beating Efficiency of the Photomixing Techniques	N.A. Mansour
ERP/CRL 87-10(TR)	Research Directions and Concerns in Canadian Coal Preparation: An Operational Perspective	N.E. Andersen M.W. Mikhail A.I. Salama O.E. Humeniuk
M&ET/CRL 87-12(OP)	Coal Reserve Assessment in Energy, Mines and Resources Canada	A.S. Romaniuk
ERP/CRL 87-13(TR)	An Overview of Micro-Processor Based Systems for Monitoring Equipment Performance	H.G. Naidu
ERP/CRL 87-15(TR)	Cross Program Software	V. Srajer N. Stuart C. Neumiller M. Heximer W. Veldhuis
ERP/CRL 87-16(TR)	Overhead Program Software	V. Srajer N. Stuart M. Heximer W. Veldhuis
ERP/CRL 87-17(TR)	Map Display Program Software	V. Srajer N. Stuart C. Neumiller M. Heximer W. Veldhuis

ERP/CRL 87-18(TR)	Digit Program Software	V. Srajer N. Stuart C. Neumiller M. Heximer W. Veldhuis
ERP/CRL 87-19(TR)	Grapher Program Software	V. Srajer N. Stuart C. Neumiller M. Heximer W. Veldhuis
ERP/CRL 87-20(TR)	Digitize/Plotter Program Software	V. Srajer N. Stuart C. Neumiller M. Heximer W. Veldhuis
ERP/CRL 87-21(TR)	A Strategy for Measuring the Rolling Resistance of Mine Haul-roads	R.J. Kolada N. Stuart
ERP/CRL 87-22(TR)	Reinforced Earth	R.J. Kolada
M&ERP/CRL 87-23(TR)	The Potential Application of Geotextiles in the Construction of Off-Highway Roads	R.J. Kolada
CRL 87-24(TR)	A Study of the Filters Used in the Dust Research Program at the Cape Breton Coal Research Laboratory	G.R. Corbett
CRL 87-25(OP,J)	Numerical Modelling Application to Rock Mechanics on a Supercomputer	C. Janakiraman B. Das
CRL 87-26(OP,J)	Application of the Stress-Property-Deformation Relation (SPDR) Integrated Method to Surface Mine Slope Stability Problem	B. Das S. Serata D.J. Nikols
CRL 87-27(TR)	Fortran Program for Weibull Parameter Estimation	J.K. Szymanski V. Srajer N.J. Stuart R. Kolada
CRL 87-28(TR)	Portal-to-Portal Dust Sampling Procedures Used at CBCRL	D.J. O'Brien

CRL 87-29(TR)	A Comparison of Respirable Dust Sampling Instruments in a Dust Chamber - November 1985	G.W. Bonnell G.R. Corbett D.A. Young
CRL 87-30(OP,J)	Application of Artificial Intelligence and Robotics to Mining	C. Janakiraman B. Das
CRL 87-31(TR)	Evaluation of some Portable Geotechnical Testing Techniques	B. Das K. Kar
CRL 87-32(TR)	A Canadian Coal Data Base Using a Commercial Data Management Program for MS-DOS Type Machine	H.G. Naidu N.J. Stuart P. Lal
CRL 87-33(TR)	Improving Slope Stability by Adopting Suitable Blasting Techniques	B. Das H.G. Naidu
CRL 87-34(TR)	Suggested Monitoring Program for the 7 West District at Lingan Colliery, Nova Scotia	P. Cain
CRL 87-35(TR)	Trials of a Rapid Clay Analysis System for Coal Mine Strata	P. Cain
CRL 87-39(TR)	Calibration Factors for the Use of the NCB Cone Indentor in the Sydney Coalfield	P. Cain
CRL 87-40(INT)	Trip Report: Vist to Fort McMurray	N.J. Stuart A.W. Stokes
CRL 87-41(TR)	Longwall Gateside Packs: Part II Design Methods	P. Cain
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CRL 87-43(TR)	Support Load Requirements for Maintaining Salvaged Facelines	P. Cain
CRL 87-44(INT)	Visit Report: École des Mines, Nancy, France, February-May 1986	P. Cain
CRL 87-45(TR)	Improvements in Pack Design at Lingan Colliery	P. Cain
CRL 87-48(TR)	Coal Research Laboratories Annual Progress Report 1986-87	Compiled by: G.A. Haslett D.B. Stewart Y. Theriault

CRL 87-49(TR)	Preliminary Specification of a Truck/Shovel Operating and Management System	V. Srajer B. McConechy
CRL 87-50(OP)	Summary Report of Cooperative USBM/CANMET Research Project to Study Methane Flow Patterns in Longwall Panels	B.W. Konda D.B. Stewart
CRL 87-51(TR)	On the Application of Knowledge Engineering to the Truck Dispatch/ Simulation Problem	N.J. Stuart R.J. Kolada
CRL 87-52(TR)	Preliminary Analysis of Easi-Miner Data Gathering Using the Polyquarter Data Logger at Obed Mountain Coal Mine	S. Neal N.J. Stuart J.K. Szymanski
CRL 87-53(TR)	Programs Developed to Use the Polycorder Data Logger to Perform Time Studies of the Easi-Miner Coaling Operation	S. Neal N.J. Stuart J.K. Szymanski
CRL 87-54(TR)	A Review of Progress in the Development of a Rolling Resistance Trailer	R.J. Kolada N.J. Stuart S. Neal
CRL 87-55(TR,OP)	An Integrated System for Coal Handling, Beneficiation, Transportation and Combustion of Canadian Coals	M.W. Mikhail J.K. Szymanski
CRL 87-56(INT)	Proposed CBCRL/CBDC Research Program to Investigate Rock Cuttability and Machine Performance in the Sydney Coalfield, N.S.	T.R.C. Aston
CRL 87-57(OP)	Geotechnical Monitoring of Tunnel Boring Machine Drivages at the Donkin-Morien Mine, Nova Scotia	J.L. Gilby C.M.K. Yuen T.R.C. Aston
CRL 87-58(INT)	Visit Report: CANMET Donkin-Morien Contract University Seminar Program, February 16 - April 7, 1987	T.R.C. Aston M. Bétournay
CRL 87-59(J)	Evaluation and Application of Spirals and Water-Only Cyclones in Cleaning Fine Coal	M.W. Mikhail A.I.A. Salama I.S. Parsons O.E. Humeniuk

CRL 87-61(TR)	Haulroad Design at Highvale Mine	R. Whipple R.J. Kolada
CRL 87-62(OP,TR)	Controlling the Hazards of Methane Explosions in Coal Storage Facilities	R.J. Kolada R.N. Chakravorty
CRL 87-63(INT)	Cape Breton Coal Research Laboratory Annual Report: FY 86-87	T.R.C. Aston G.W. Bonnell G.A. Haslett B.W. Konda
CRL 87-64(INT)	The Influence of Shape upon the Support of Roadway Intersections	G.A. Haslett
CRL 87-65(J,OP)	Resolving Complex Mine Ventilation Problems with Multiple Tracer Gases	D.J. Kennedy A.W. Stokes W.G. Klinowski
CRL 87-66(OP,J)	Measuring Methane Flow Patterns on Advancing Longwall Panels	B.W. Konda A.B. Cecala
CRL 87-67(OP)	Coal Research Laboratories Presentation to the Standing Senate Committee on Energy and Natural Resources, Ottawa, May 11, 1987	A.S. Romaniuk
CRL 87-68(J,OP)	Technology Transfer and Acceptance Key to Increased Productivity in Oil Sands Mining	R.K. Singhal
CRL 87-69(TR)	Predicted Seafloor Subsidence Profile Data Using the NCB Subsidence Engineers Handbook for the Prince, Lingan and No. 26 Mines, Sydney Coalfield, N.S.	T.R.C. Aston
CRL 87-70(TR)	A Comparison of Point Load Index and Laboratory Derived Rock Property Data from the Lingan Mine, Sydney Coalfield, N.S.	T.R.C. Aston
CRL 87-71(TR)	Blast Casting at Minto Coal Mine, New Brunswick	H.G. Naidu
CRL 87-72(TR)	Visit to Northeast B.C. Coal Mines	H.G. Naidu K. Kar

CRL 87-73(INT)	ASTM Committee D-5 on Coal and Coke: May 1987 Meeting and Visit to U.S. Bureau of Mines, Pittsburgh	G.W. Bonnell
CRL 87-74(TR)	Pump Calibration Procedures for Dust Sampling Instruments Used at CBCRL	D.A. Young
CRL 87-76(TR)	An Analytical Method for Determining Trace Levels of Sulfur Hexafluoride, Bromotrifluoromethane and Dichlorodifluoromethane in Mine Air Samples	D.J. Kennedy
CRL 87-77(TR)	Slope Stability Monitoring Using Precision and Reliability Measures Derived from Least-Squares	A.B. Kempe
CRL 87-78(TR)	Pilot Plant Scale Evaluation of Beneficiation Potential of Donkin-Morien Coal, N.S.	M.W. Mikhail O.E. Humeniuk A.I.A. Salama I.S. Parsons
CRL 87-79(TR)	Pilot-Scale Study on BATAC Jig Washing of Bryan Mountain Coal Crows Nest Resources	M.W. Mikhail I.S. Parsons O.E. Humeniuk
CRL 87-80(TR)	Pilot-Scale Study on BATAC Jig Washing of Wapiti Coal Gulf Canada Resources Ltd.	M.W. Mikhail I.S. Parsons O.E. Humeniuk
CRL 87-81(TR)	Pilot-Scale Study on BATAC Jig Washing of Coarse Refuse - Westar Coal Ltd.	M.W. Mikhail I.S. Parsons O.E. Humeniuk
CRL 87-82(OP,J)	Flocculation of Colloid Particles by Water Soluble Polymers	S. Levine W. Friesen
CRL 87-83(TR)	Pilot-Scale Study on BATAC Jig Washing of Kipp Mine Coal	M.W. Mikhail I.S. Parsons
CRL 87-84(TR)	Cone Penetrometer Testing at Gregg River Mine	R. Whipple R.J. Kolada
CRL 87-85(INT)	The Study of Coal and Clay by Photoacoustic FTIR Spectroscopy	Z. Shu

CRL 87-86(J,OP)	Rock Support Interaction Study of a TBM Driven Tunnel at the Donkin-Morien Mine, Nova Scotia	C.M.K. Yuen J.M. Boyd T.R.C. Aston
CRL 87-87(OP)	Coal Research and Development in Canada	T.D. Brown D.A. Reeve
CRL 87-89(OP)	Methane in Coal Mines	B.W. Konda
CRL 87-90(TR)	Remote On-Board Coal Quality Sensing Techniques in Coal Cutting and Handling Systems	J.K. Szymanski T.S. Golosinski V. Srajer
CRL 87-91(TR,OP)	Recent Developments in the Prevention and Control of Spontaneous Combustion in Coal Mining Operations	R.N. Chakravorty R.J. Kolada
CRL 87-93(J,OP)	Predesign Considerations of Waste Dumps in Western Canadian Surface Mines	R.K. Singhal
CRL 87-94(OP)	Potential Applications of Knowledge Based Systems in Mining	R.K. Singhal K.Y. Fytas J.L. Collins F. Flament A. Galibois
CRL 87-95(OP,TR)	Concentration Measurements in Emulsions	N.A. Mansour
CRL 87-96(J)	Generalized Nonlinear Theory for One-Port Microwave Active Circuits	N.A. Mansour W.R. Tinga
CRL 87-103(OP)	Characterization of Upgraded Low-Rank Coal by Fractal Dimension	W.I. Friesen R.J. Mikula
CRL 87-104(OP)	Characterization of Coal Oxidation In Situ and on a Stockpile	D.E. Axelson R.J. Mikula V.A. Munoz
CRL 87-106(OP,J)	Application of the Stress-Property-Deformation Relation (SPDR) Technology to Underground Mine Design Optimization	S. Serata B. Das K. Shrinivasan V.J. Hucka
CRL 87-107(OP,J)	Software for the Numerical Evaluation of Conveyor Belt Lengths as a Function of the Installed Power	J.K. Szymanski N.J. Stuart

CRL 87-108(TR)	Development Schedule for the Rolling Resistance Trailer	R.J. Kolada
CRL 87-109(TR)	Gregg River CBR Test Results	R. Whipple R.J. Kolada
CRL 87-110(TR)	Applying Artificial Intelligence Techniques to Mining Problems - Problems of Dragline Selection	C. Newmiller N.J. Stuart
CRL 87-111(TR)	Software for Digitizing and Plotting Figures	C. Newmiller
CRL 87-112(OP,J)	Two Approaches to the Computerized Planning of Dragline Operation	N.J. Stuart M.Q. Cobb
CRL 87-114(TR,J)	Canadian Coal Preparation Process Control Research and Development Directions	A.I.A. Salama
CRL 87-115(OP,J)	Techniques for Stress Analysis in Mines on a Supercomputer	B.M. Das C. Janakiraman V.J. Hucka A. Prasad
CRL 87-116(TR)	An Improved Technique for the Determination of Spontaneous Combustion Susceptibility of Coals	N.A. Mansour R.N. Chakravorty
CRL 87-117(INT)	Automatic Control Strategy for Continuous Operation of a Gravity Thickener	N.A. Mansour
CRL 87-118(J)	A Review of Archival Geophysics Data to Identify Seafloor Longwall Subsidence Profiles	T.R.C. Aston T. Lapierre J.McG. Stewart
CRL 87-119(J)	A Comparison of Rock Mass Disturbance in TBM and Drill and Blast Drivages at the Donkin Mine, Nova Scotia	T.R.C. Aston J.L. Gilby C.M.K. Yuen
CRL 87-120(TR)	'WILSN-CL' Users Guide: IBM-PC/AT Computer Calculation of Diametric Tunnel Closure Using the NCB Wilson Formula	P. Kearney T.R.C. Aston
CRL 87-121(OP,TR)	Recent Developments in Mechanization in Underground Coal Mining	R.K. Singhal

CRL 87-122(OP,TR)	Western Canadian Surface Mining Technology	R.K. Singhal D.B. Stewart T.S. Golosinski P. White
CRL 87-123(OP,TR)	Methane Desorption in Coal Handling	B.M. Das
CRL 87-124(TR,OP)	An Automatic Vehicle Status, Location and Allocation System for Surface Mines	E.J. Krakiwsky A.B. Kempe V. Srajer H.A. Karimi T. Lockhart R. Wade
CRL 87-125(OP)	IMM/Atlas Copco Bursary Report: Current Rock Bolting Practices in Sweden and the United Kingdom and their Application to the Sydney Coalfield, Nova Scotia	T.R.C. Aston
CRL 87-126(TR))	Graphics Modifications to the U.S. Bureau of Mines Monver3.BAS Subsidence Prediction Program	B. Keddy T.R.C. Aston
CRL 87-127(TR)	Nova Scotia Coal Resources Evaluation Project: Progress and Status of Coal Chemistry File January 1, 1986 to March 31, 1987	G.W. Bonnell L.S. O'Leary G.R. Corbett D.A. Young
CRL 87-128(INT)	ASTM Committee D-5 on Coal and Coke: October 1987 Meeting	G.W. Bonnell
CRL 87-131(TR)	Fossil Fuels: Age and Amount	B. Das V.J. Hucka
CRL 87-132(OP,J)	Equipment Performance Monitoring	G.B. Gould B. McConechy V. Srajer
CRL 87-133(OP,J)	Cooperative Development of an Integrated Truck/Shovel Operating and Management System	V. Srajer
CRL 87-134(TR)	Fly Ash/Cement Packing for Lingan Mine: Final Appraisal and Trial Proposal	P. Cain A. Harvey T.R.C. Aston
CRL 87-135(TR,J)	M Curve and Theoretical Optimization of Parallel Coal Washing Circuits	A.I.A. Salama

CRL 87-136(INT)	Measures that Can Be Taken to Relieve Heavy Ground Pressure on Roadways formed within Coal Mines	G.A. Haslett
CRL 87-138(TR)	Iron Ore Mining in Erzberg Austria	V. Srajer
CRL 87-139(TR)	Visit Report - Concol System Ltd. Chesterfield, U.K.; British Coal, Bretby, U.K.; Bergvau Foreschung, Essen, FRG and Field Visits March 23 - April 3, 1987	A.I.A. Salama
CRL 88-1(TR)	Predicted Seafloor Subsidence Profile Data Using a "Modified" NCB Subsidence Engineers Handbook Method for the Prince, Lingan and No. 26 Mines, Sydney Coalfield, N.S.	T.R.C. Aston
CRL 88-2(J)	Exploration Borehole Sealing Requirements for the Coal Mining Industry	T.R.C. Aston H.U. Bielenstein H.A. Anderson
CRL 88-3(OP,J)	The Application of Hydrofracturing Techniques for the Prevention of Outburst Occurrences at No. 26 Colliery, Sydney Coalfield, Nova Scotia	T.R.C. Aston H.U. Bielenstein H.A. Anderson
CRL 88-4(INT)	A Brief Summary Report on the Status of the Use of Water Jet Assistance to Shearers and on the Use of Higher Water Pressures on Shearers	G.A. Haslett
CRL 88-6(OP,J)	Influence of Blasting on Open Pit Economics	H.G. Naidu R.K. Singhal
CRL 88-7(TR)	3-D Least Squares Adjustment Program for the Adjustment and Analysis of 3-D Surveying Networks (Program Methodology and User Guide)	A.B. Kempe
CRL 88-8(TR)	"Slip Effects" in Concentrated Emulsions	R. Pal E. Rhodes N.A. Mansour
CRL 88-9(TR)	Spontaneous Combustion of Coal - Discussion Summary	N.A. Mansour

CRL 88-10(OP,J)	A New Technique to Combat Methane Gas Hazards	R.N. Chakravorty P.I. Forrester W. Richards
CRL 88-11(OP,J)	Experience with Cast Blasting in Canadian Surface Coal Mines	H.G. Naidu R.K. Singhal

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ERP/CRL 87-11(CF)	Carbon-13 Solid State NMR of Pitch. Part 2	D.E. Axelson Y. Theriault
ERP/CRL 87-14(CF)	The Demulsification Ability of Romanian Chemicals	J.M. Chu S.P. Twa G.P. Zuber Y.T. Theriault D.E. Axelson
CRL 87-36(CF)	Coker Feeds Bitumen/Slurry Variability	R.J. Mikula D.E. Axelson
CRL 87-37(CF)	Origin of Anomalous Oil Content Analyses of Oil Sands by Nuclear Magnetic Resonance Spectroscopy	D.E. Axelson R.J. Mikula Y. Theriault N.E. Andersen
CRL 87-38(CF)	Mobile Water Treatment Plant Testing at the Obed Washery: June - December 1985	K.A. Hashmi Z.M. Potoczny W.M. Leung C.G. Frenette
CRL 87-46(CF)	Preliminary Evaluation of a Commercial Korean Fuel Log	R. Zrobok V.A. Munoz Y. Theriault
CRL 87-47(CF)	Mobile Plant and Water Treatment Testing at the Crows Nest Resources Ltd. Line Creek Washery during 1983	J.L. Picard K.H. Hashmi Z. Potoczny
CRL 87-60(CF)	Fluorescence Microscopy and Image Analysis of Selected Tar Sand Emulsions	V.A. Munoz R.J. Mikula D.E. Axelson
CRL 87-75(CF)	Initial Measurements of Mine Haul Road Rolling Resistance at the Syncrude Oilsands Mine near Fort McMurray	R.J. Kolada N.J. Stuart S.J. Neal

CRL 87-88(CF)	A Technical Note: An Investigation into the Causes of a Fall that Occurred on 2W Top Material Road at Phalen Colliery	W.D. Gallant G.A. Haslett
CRL 87-92(CF)	Equipment Productivity Statistics from Selected Surface Coal Mines in Canada	V. Srajer
CRL 87-97(CF)	Fluorescence Study of Selected Refinery Products	R.J. Mikula V.A. Munoz
CRL 87-98(CF)	Evaluation of Froth Settling Characteristics Elevated Temperature and Pressure	R.J. Mikula V.A. Munoz G. Zuber S.P. Twa
CRL 87-99(CF)	Determination of the Carbonization of a Forestburg Char Sample	W.M. Leung V.A. Munoz R.J. Mikula
CRL 87-100(CF)	Evaluation of Froth Settling Characteristics as a Function of Temperature	R.J. Mikula V.A. Munoz G. Zuber
CRL 87-101(CF)	Suncor Field Study: Characterization of Extraction Plant Emulsions Using Optical Microscopy	R.J. Mikula V.A. Munoz D.E. Axelson
CRL 87-102(CF)	Analysis of Oxidized Polymeric Materials	D.E. Axeslon Y.T. Theriault K.H. Michelian
CRL 87-105(CF)	Evaluation of Alum from C-I-L Inc for Coal Valley Effluent Treatment	R. Frenette J. Picard H.A. Hamza
CRL 87-113(CF)	Mica Characterization in Oilsands	D.E. Axelson R.J. Mikula K.H. Michaelian N.E. Andersen D. Syme
CRL 87-129(CF)	Microscopic Characterization of Selected Resins	R.J. Mikula V.A. Munoz
CRL 87-130(CF)	Rolling Resistance Measurements at Suncor Tarsands Mine	R.J. Kolada

CRL 87-137(CF)	Recovery of Coal from Elkview Plant Refuse by Using Spirals	M.W. Mikhail O.E. Humeniuk I.S. Parsons
CRL 87-140(CF)	Natural Gamma Emission Analysis of Bienfait Coal, Bone, Brown Clay and Grey Clay	G.W. Haverland L.I. Wiebe T.S. Golosinski J.K. Szymanski V. Srajer
CRL 88-5(CF)	Dewatering of Sludge Produced from the Pretreatment of Produced Water at Murphy Oil's Lindbergh In Situ Heavy Oil Production Site	K.A. Hashmi G.P. Zuber
CRL 88-12(CF)	Respirable Dust Measurements made at the Top 7 West Development Heading at Prince Colliery during the Period July 6, 1987 - July 16, 1987: Part I	G.W. Bonnell G.R. Corbett W.G. Klinowski L.S. O'Leary D.A. Young
CRL 88-13(CF)	Notes on Application of the MMS's Dispatch System	V. Srajer
CRL 88-14(CF)	A Comparison of the Casella Simpeds Cyclone with the Casella Type 113A Respirable Dust Sampler	G.W. Bonnell

APPENDIX E: REPRESENTATION ON TECHNICAL COMMITTEES

INTERNATIONAL

American Society for Testing Materials

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CANMET/USBM "Memorandum of Understanding"

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Coordinator ..... T.D. Brown

Project Leader ..... M.W. Mikhail

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CAPCC (representative)	B. Das
Publication Committee (member)	B. Das
Editor, Coal Division Newsletter	R.K. Singhal
AGM Program Committee (Chairman)	D.B. Stewart
Research Grant Committee (Chairman)	D.B. Stewart

- Computer Application and Process Control Committee

Executive Committee (member)	B. Das
Publications (Chairman)	B. Das

Advisory Committee for Canada-Saskatchewan Project on Pipelining of Heavy Crude Oils

Member	M.W. Mikhail

Committee on Atlantic Coal

Member	T.D. Brown
Coal Beneficiation Working Group (member)	M.W. Mikhail

National Advisory Committee on Mine Automation

Member	R.K. Singhal

CANMET - The Mineral and Metal Recovery Biotechnology Research Network (BIOMINET)

CRL Representative	R.N. Chakravorty

PUBLICATIONS AND SYMPOSIA

International Journal of Mine Water

Canadian Editor ..... T.R.C. Aston

Sixth International Congress on Rock Mechanics

Pre-Congress Tour Organizer ..... T.R.C. Aston

INTERNATIONAL PUBLICATIONS

Fuel Processing Technology

Editorial Advisory Board ..... H.A. Hamza

Coal Preparation - A Multinational Journal

Editorial Board ..... M.W. Mikhail

Eleventh International Coal Preparation Congress Organizing Committee

Canadian Representative M.W. Mikhail

International Journal of Surface Mining

Co-Editor ..... R.K. Singhal

Research Associate ..... H.G. Naidu

Research Associate ..... R.J. Kolada

World Mining Equipment

Editorial Advisory Board ..... R.K. Singhal

International Symposium on Mine Planning and Equipment Selection

Co-Chairman - Symposium Organizing Committee ... R.K. Singhal

Symposium Organizing Committee - Member ..... H.G. Naidu

Second International Conference on Robotics and Factories of the Future

International Organizing Committee (Member)..... B. Das

World Energy Conference - Committee on Low Grade Coals

Canadian Representative ..... A.S. Romaniuk

Eighth International Strata Control Conference Organizing Committee

Canadian Representative ..... D.B. Stewart

Twenty-Third International Conference of Safety in Mines Research Institutes

Canadian Representative ..... D.B. Stewart

Computers and Mining

Contributing Editor ..... R.K. Singhal

National Symposium on Surface Mining, Hydrology, Sedimentology, U.S.A.

Technical Program Committee ..... R.K. Singhal

International Symposium on Off-Highway Haulage in Surface Mines

Co-Chairman ..... V. Srajer

First Canadian Conference on Computer Applications in the Mineral Industry

Co-Chairman ..... R.K. Singhal

Canadian Mining Journal

Editoral Advisory Board ..... R.K. Singhal

APPENDIX F: RESEARCH CONTRACTS, JOINTLY FUNDED WORK AND COST RECOVERY WORK

RESEARCH CONTRACTS

CAPE BRETON COAL RESEARCH LABORTORY

Title	Investigator	Scientific Authority	Status March 31/87
Determination of Seafloor Topography over the New Phalen Mine Workings, Sydney Coalfields, N.S.	McGregor Geoscience Ltd. Halifax, N.S.	T.R.C. Aston	Completed
A Review and Evaluation of Existing and Potential Main Roadway Intersection Support Techniques for Use in the Sydney Coalfield, N.S.	Golder Associates Ltd. Toronto, Ont.	T.R.C. Aston	Completed
Development of Finite Element Techniques for the Design of Steel Support Systems with Particular Reference to the Donkin-Morien Rock/Support Interaction Study	McGill University Montreal, P.Q.	T.R.C. Aston	Continuing
An Evaluation of Point Wear and Sample Shape on Point Load Test Indices	Maritime Testing Ltd. Halifax, N.S.	T.R.C. Aston	Continuing
A Review and Evaluation of Strata Reinforcement Techniques Combined with Overcoring Methods to Determine the In Situ Stress Regime of Coal and Weak Coal Measures Strata	Strata Engineering Corporation Toronto, Ont.	T.R.C. Aston	Completed

Title	Investigator	Scientific Authority	Status March 31/87
A Study of the Influence of Sandstone Channels on Coals from the Sydney Basin: Mineralogy Coking and Thermal Characteristics	Atlantic Coal Institute Sydney, N.S.	G.W. Bonnell	Continuing
Development and Laboratory Validation of a Theoretical Model of Rock/Gas Outbursts for the Sydney Coalfield	Golder Associates Ltd. Toronto, Ont.	G.A. Haslett	Completed
Remote and Automatic Control Systems for Longwall Mining - A Review Report on Potential Applications for the Sydney Coalfield	Associated Mining Consultants Ltd. Calgary, Alta.	G.A. Haslett	Completed
Short Longwall Retreat Systems for Broken Workings - A Review Report on their Possible Applications for the Sydney Coalfield	Monenco Consultants Ltd. Calgary, Alta.	G.A. Haslett	Completed
Design and Construction of an Apparatus to Conduct Methane Gas Studies on Canadian Coals	Zenon Environmental Inc. Burlington, Ont.	B.W. Konda	Completed
Operational Experience with the Conspec Remote Environmental Monitoring System in an Operating Underground Canadian Coal Mine	Cape Breton Development Corporation Sydney, N.S.	B.W. Konda	Completed

Title	Investigator	Scientific Authority	Status March 31/87
A Detailed Review and Evaluation of Predrainage Techniques and their Applicability to Canadian Coal Mines	Associated Mining Consultants Ltd. Calgary, Alta.	B.W. Konda	Complete
Modelling Methane Flow into Underground Longwall Coal Mines	Lobbe Technologies Ltd. Regina, Sask.	B.W. Konda	Completed
Design of an Intrinsically Safe Instrument Package for a Portable Gas Chromatograph	Atlantic Nuclear Sevices Ltd. Fredericton, N.B.	D.J. Kennedy	Completed

SURFACE MINING LABORATORY: DEVON

Title	Investigator	Scientific Authority	Status March 31/87
Application of the Stress-Property-Deformation-Relation (SPDR) Integrated Method in Determining Surface Mine Stability	Serata Geomechanics Inc. Richlands, California	B. Das	Completed
Assess Field Techniques Used to Determine In Situ Bulk Density of Coal and Plan an Appropriate Program of Field Work	Norwest Resource Consultants Ltd. Calgary, Alberta	A.S. Romaniuk	Completed
Determining Geotechnical and Hydrogeological Properties of Overburden in Oil Sands Mining using Downhole Geophysics	TransAlta Utilities Corp. Calgary, Alberta	B. Das	Completed

Title	Investigator	Scientific Authority	Status March 31/87
Improvement and Demonstration of the Rheological Element Model (REM) to Open Pit Design Optimization	Serata Geomechanics Inc. Richmond, California	B. Das	Continuing
Study on the Dynamic Stability of Waste Dumps in Surface Coal Mines at the Smoky River Coal Limited	Smoky River Coal Limited Grande Cache, Alberta	B. Das	Completed
Evaluation of Supercomputing Technology for Surface Coal Mining Geotechnical Modelling Applications	University of Calgary Calgary, Alberta	B. Das	Completed
Demonstration and Evaluation of an Integrated Truck Management System in a Producing Canadian Surface Coal or Oil Sands Mine (A Cost-Shared Project)	Gregg River Resources Ltd. Hinton, Alberta	V. Srajer	Completed
Biological Control of Methane in Coal Mines, Coal Storage Silos and Shipholds - Phase V	Gemini Biochemical Research Ltd., Calgary, Alberta	R.N. Chakravorty	Completed
Detailed Study of the Reaction Mechanism of Spontaneous Combustion of Coal with Particular Emphasis on Western Canadian Low Rank Coal - Phase II	University of Calgary Calgary, Alberta	R.N. Chakravorty	Completed

Title	Investigator	Scientific Authority	Status March 31/87
Demonstration and Evaluation of Blast Casting in a Producing Canadian Surface Coal Mine	Fording Coal Ltd. Elkford, British Columbia	H.G. Naidu	Completed
Design, Construction and Testing of a Multipurpose Radio Telemetry System for Use in Open Pit Mines - Phase I	A.S.W. Computer Systems Ltd. Port Credit, Ontario	N.J. Stuart	Continuing

RESEARCH CONTRACTS

FUEL PROCESSING LABORATORY

Further Development, Testing and Application to Coals Using a Conical Fuildized Bed	St. Francis Xavier Antigonish, Nova Scotia	W.I. Friesen	Completed
A Study of Electrostatic Separation of Water-In-Oil Emulsions	Dr. S. Levine Vancouver, British Columbia	W.I. Friesen	Completed
Theoretical Study of the Electrostatic Coalescence of Water-In-Oil Emulsion	Dr. S. Levine Vancouver, British Columbia	W.I. Friesen	Continuing
Coal and Water Analysis Coal Water	 Cyclone Engineering Chemex	 I.S. Parsons K. Hashmi	 Continuing Continuing
Development of a Pilot Plant for Deep Coal Cleaning	Dillingham Construction Ltd.	M.W. Mikhail	Completed

Title	Investigator	Scientific Authority	Status March 31/87
A Study to Determine the Relationship Between Bound and Unbound Polyacrylamide and Flocculation Rate	St. Francis Xavier	C.W. Angle	Continuing
The Development of a Coal Research Business Plan	The Coal Association of Canada	T.D. Brown	Continuing

COST RECOVERY AND COLLABORATIVE RESEARCH

Cost recovery and collaborative projects were undertaken on behalf of western Canadian industries during FY 87-88 and reported, on a confidential basis, to the research clients. The listings below illustrate the distribution of these projects between the technology areas in which the division operates.

Cost Recovery Activities

Coal Technologies

Carbonization	5 Companies
Spontaneous Combustion	2 Companies
Methane Desorption	2 Companies

Bitumen Oil Emulsion Technologies:

Oil Companies	2 Companies

Collaborative Activities

Formal financial agreements support the projects identified below. Cooperative projects without formal cost sharing agreements are not included but they are also significant.

	Company Contribution ($000's)	CANMET Contribution ($000's)
OBDAS Truck Management	155	100
Blast Casting	141	94
Downhole Geophysics*	87	36
Dynamic Stability of Waste Dumps	90	70
Biological Control of Methane**	20	22
Rheological Element Model	76	44
Supercomputing	72	30
Coal Research Business Plan	45	45

* DSS Unsolicited Proposal Fund ($31K) Contribution Not Included

** Transport Canada ($45K) Contribution Not Included.

APPENDIX G: CONTACTS MEETINGS & FIELD TRIPS

CAPE BRETON COAL RESEARCH LABORATORY

Discussion with Cape Breton Development Corporation (CBDC) staff has remained a normal day-to-day event as have visits to CBDC mines by CBCRL staff.

The comparative isolation of CBCRL relative to other CANMET and CRL facilities predicates a requirement that scientists must travel to present papers, to exchange information and to discuss ongoing research with other scientists. Such travel serves to keep CBCRL staff abreast of relevant developments elsewhere and avoids duplication of effort.

An example from among a number during the past year was the participation of a scientist from this laboratory as an author and as a member of the organizing committee for the 6th Conference of the International Society for Rock Mechanics hosted by Canada in Montreal during the month of September. The scientist was also the organizer and host of a post-conference tour of CBDC underground operations and of this laboratory. The post-conference tour included participants from Norway, Japan and the U.S.A. all of whom expressed their appreciation.

The relevance of CBCRL programs to industry needs is assured by frequent formal and informal contact during all phases of each project. Laboratory staff lead a number of informal technology specific working parties that serve as a fertile spawning ground for research ideas. They are also lively participants in day-to-day CBDC technical problem solving discussions. These discussions coupled with the frequent visits to CBDC mines ensure that laboratory staff remain up to date and aware of developments within the mines of their main client.

SURFACE MINING LABORATORY

On March 7-9, 1988 the First Canadian Conference and Exhibition on Computer Applications in the Mineral Industry was held at Laval. SML was instrumental in organizing this symposium; that CANMET was amply represented (10 of the 89 papers include CANMET authors).

This is the fifth major conference that SML has helped organize in the past three years. Successful conferences demand careful planning and attention to detail. The Laval conference and exhibition was as successful as CRL's previous endeavours in this field. In addition to such formal conferences the laboratory also routinely conducts public debriefings of all completed projects and hosts seminars on topics of generic industrial interest.

The Laboratory maintains continuous contact with foreign and off-shore research organizations, mine operators and equipment manufacturers. Staff participate actively in national and international technical committees and maintain contact, including guest lecturing, at Canadian Universities. These actions ensure that we remain current and allow us to assess the potential future impacts of emerging and new developments in the Canadian context.

Contracts, Meetings and Field Trips

The past year has seen an increase in personal contacts with the industry; significantly, an increasing number of scientific staff are routinely interacting with outside organizations. Within the context of the CANMET Business Plan, one objective of these contacts is to foster an awareness of problems and of capabilities and to generate ideas for collaborative and/or cost recovery research projects. Seminars which focus on a singular topic, e.g. column flotation, on-line ash monitors, were found to be particularly useful to bring interested parties together to discuss "state-of-the-art" and formulate R&D initiatives.

Research staff interact with personnel from coal, oil, chemical and equipment companies; contacts are maintained with a broad spectrum of research organizations, educational institutes and consultants. Collaborative efforts within the Coal Research Centre Devon, e.g. with Alberta Research Council, have broadened substantially.